THE
# TROPICAL AGRICULTURIST:
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## THE USE OF TRACTORS ON COCONUT ESTATES.

The report of the Ceylon Tractor trials which are given in the present number of the TROPICAL AGRICULTURIST should be of value to all interested in the cultivation of coconuts.

In our last number the general experience of growers in Ceylon in the cultivation of coconuts was briefly reviewed and the uses of tractors indicated.

Tractors have now been utilised upon coconut estates in Ceylon for the past three years and useful work both in ploughing and in disc-harrowing has been performed.

The competitive trials which have recently been held were designed to demonstrate the relative values of tractors in the Colony for work on coconut estates. Areas were ploughed, cross-ploughed and subsequently disc-harrowed. The illustrations indicate the type of work that was performed and visitors to the trials were interested in the possibilities of tractors for work upon coconut estates.

The tractor is capable of performing much deeper ploughing than when animal traction is employed and work can be done even in very dry weather when the ground would normally be too hard for work with either cattle or buffalos. Similarly, heavier and larger implements can be utilized for harrowing and work thereby performed more rapidly. In some quarters there is a belief that on the sandy coconut lands of the coastal regions good deep disc-harrowing with tractors would afford adequate cultivation.

The initial cost of a tractor and its outfit is heavy and therefore only the larger estates are likely to be in a position to afford the capital outlay, but it is possible that neighbouring estates could co-operate together to purchase a tractor outfit for use upon their estates or that provision could be made by the owner of a tractor to hire it for work on other estates in the neighbourhood.

Similarly, it is possible that organizations could be formed solely for hiring tractors to estates for definite contract work.

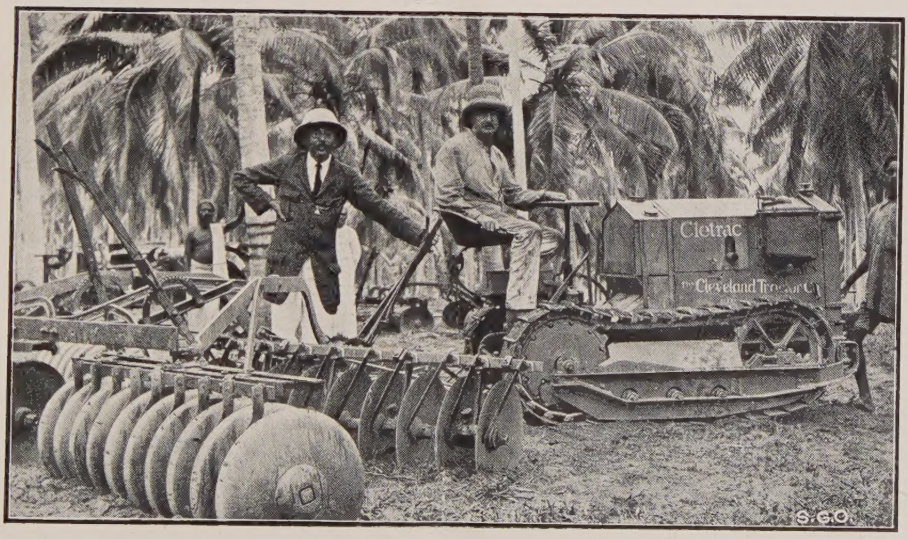
Such co-operation for the use of tractors or for hiring out for definite pieces of work is common practice in all countries where tractors have now found a place in their agricultural economy and is well worth serious consideration by coconut growers in the Colony.

The tractor to be an economical unit must be found continuous work throughout the year, and if an estate is not large enough to provide this work then other arrangements should be made whereby the maximum output is obtained. If such co-operation is possible or if hiring companies can be formed there are good prospects before tractors on the coconut estates of the Colony and the trials recently held in the Kurunegala district should be of considerable value.

The general consensus of opinion amongst progressive coconut growers is that cultivation in the drier districts should not be carried on at too frequent intervals. The maintenance of the humus-content of the soil has to be kept continuously in view and if green manure plants are not grown between the rows of coconuts then a certain amount of grass and weeds should be allowed to grow in order that they may be turned into the soil.

The effects of the deeper ploughing which will be possible with the use of tractors will be watched with interest and coconut planters are asked to keep accurate records of the crops from those fields which have been deep ploughed and subsequently thoroughly cultivated.

CLETRAC AT WORK—PLOUGHING.




CLETRAC WITH DISC HARROW.

NATURE OF WORK DONE.

NATURE OF WORK DONE.

# TRACTOR TRIALS IN CEYLON, 1921.

## TRACTOR TRIALS IN CEYLON.

Competitive Tractor trials were held, with the kind permission of the Directors of the Ceylon Coconut Co., Ltd., on Clovis Estate, Kurunegala, on June 17th and 18th.

These trials were designed to bring out the relative merits for work upon coconut estates of the various types of tractors in the Island. Areas of 4·3 acres of old coconuts were marked out, and the Tractors were required to plough this area, cross-plough it, and finally to disc-harrow the ploughed area. It was stipulated that the ploughing should be to a depth of 6 inches and that it should be carried out to a distance not greater than 2 feet from the trunks of the palms.

The selected area was cleared previous to the trials of all fallen branches and nuts.

The soil of the selected area was slightly undulating and was typical of the Kurunegala district. It was gravelly over fully half and the remainder was a fair loam, rather sandy in parts. It had been ploughed with buffalos to a depth of between 2 and 3 inches two years previously and was at the time of the trials, owing to the prolonged drought, hard.

Every endeavour was made to have the plots of the same length and breadth so that the amount of turning by the Tractors would be equal. Plots 2, 3 and 4 were of the same length and breadth, while Plot 5 was, owing to a hollow at the lower end, slightly shorter than the remainder and was one row of coconuts wider.

Lots were drawn for the various plots and the trials began at 8 a.m. on the 17th. They were terminated at 4 p.m. on the 18th. The weather throughout was fine, except for one heavy shower in the latter part of the afternoon of the second day.

### PLOT 2—SAUNDERSON.

The land on this plot was somewhat harder than the other plots, the gravelly soil on the higher part of the hill slope being exceedingly hard. This outfit occasioned some delay at the outset owing to its ploughs not being properly set. Loss of time was also experienced by reason of a water connecting pipe bursting in the afternoon of the first day. Ploughing was well done at the beginning but was shallower on the second day. Cross-ploughing and disc-harrowing was fair. This Tractor is a powerful one and had no difficulty in ploughing to the required depth even in hard ground.

### PLOT 3—CLETRAC.

The land on this plot consisted of hard gravelly soil on the higher portions and light sandy loam in the lower areas. This Tractor had no stoppage, except for a few minutes for adjustment of carburettor, throughout

the trials. The ploughing at first was slightly shallower than 6 inches in depth, especially in the hard gravelly areas, but the depth was improved later—especially after a reduction of the speed at which the Tractor was driven. The general quality of the work also improved after the first three rows between palms were completed. Cross-ploughing was thoroughly done and a uniform depth of ploughing of 6 inches in depth was secured. Disc-harrowing was well carried out. This Tractor turns easily in a small compass and most visitors were impressed by its work and general handiness. It was awarded the Gold Medal by the Judges.

**PLOT 4—AVERY.**

This plot had less of the hard gravelly soil, but in the sandy loam there were a few soft sandy patches which caused the Tractor much trouble. The Tractor throughout the trial was run on petrol, as the Agents did not wish to foul the engine by the use of kerosene. It used a double-mould board plough giving a 12-inch cut, but was unable with this plough to reach the required depth of 6 inches except in the softer and sandier parts of the plot. It is possible that with a disc plough better results would have been secured under the dry conditions which prevailed at the time the trials were held. In the soft sandy patches the tractor lost much time. It was held up by the plough going down to a considerable depth, by skidding and by having to back to get out of these sandy areas. The cross-ploughing was only fair but the discing was better.

The Tractor throughout gave no trouble, but an air-washer was damaged by collision with a palm.

**PLOT 5—FORDSON.**

This plot of land was, on the whole, lighter in character than either plots 2 or 3 but it was too hard for satisfactory work by the outfit used with this Tractor. Great difficulty was experienced in keeping the double-furrowed plough in the ground, and the ploughing depth except in sandy areas did not average more than two inches in depth. Cross-ploughing and disc-harrowing was slightly better.

The Judges made careful inspection of all work done throughout the trials and kept notes of time taken for work performed and of fuel consumption. The details of the results of the work of the different Tractors at these trials are appended to this Report, and I have to thank the Ceylon Coconut Company, for the loan of a portion of Clovis Estate for the trials, the Superintendent for preparing the area and the Judges that assisted me for the painstaking manner in which they carried out their duties in connexion with the Trials.

F. A. STOCKDALE,
Director of Agriculture.

**PLOT 2—SAUNDERSON.**

| | | |
|---|---|---|
| 1 | Name of Tractor : | SAUNDERSON, |
| 2 | Ceylon Agents : | Hoare & Co., Colombo. |
| 3 | Cost of tractor, Colombo: | Rs. 8,950 |
| 4 | Cost of implements, Colombo : | Oliver D43—3 disc plough Rs. 1,020<br>Double twelve disc harrow Rs. 775 |
| 5 | Weight of Tractor : | ——— |
| 6 | H. P. of Tractor : | 23—25 h. p. |
| 7 | No. of furrows ploughed : | 3 |
| 8 | No. of attendants : | Driver and one assistant. |

SAUNDERSON.

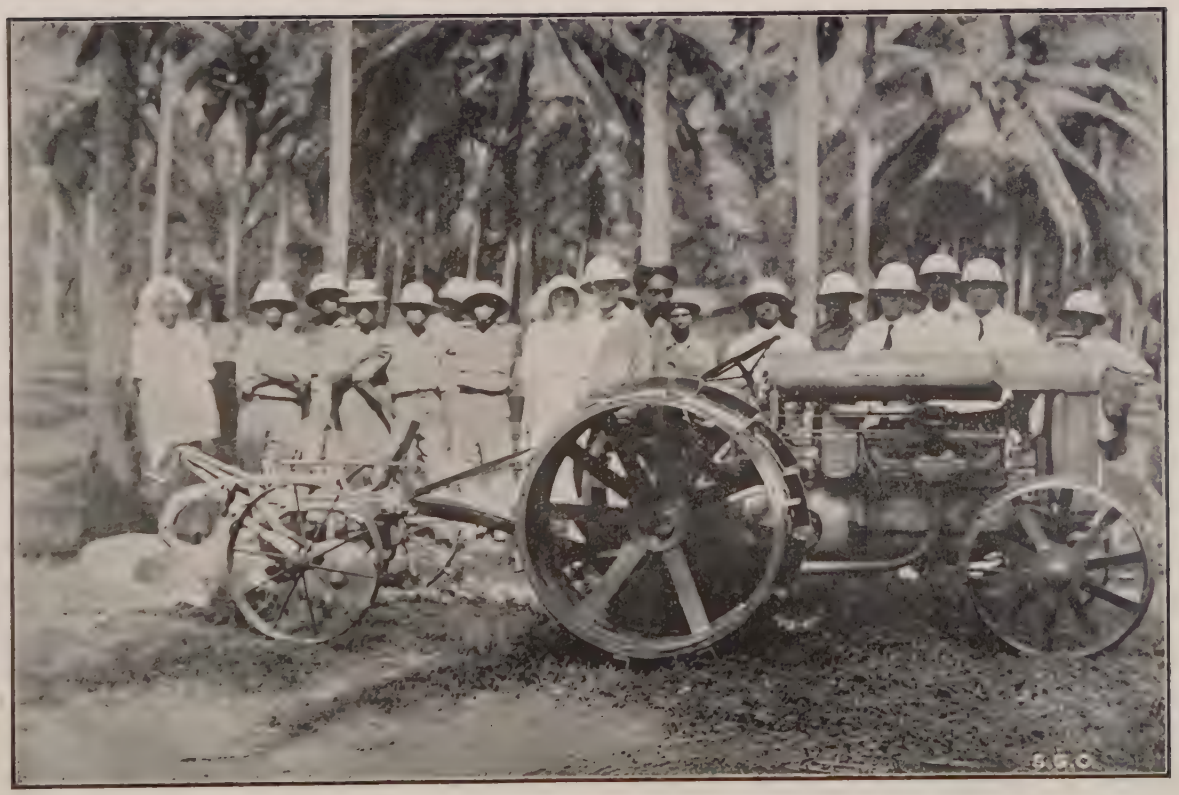
CLETRAC.

| | | | | |
|---|---|---|---|---|
| 9 | Time in hours per acre : | (A) ploughing ... | 1·94 hrs. |
| | | (B) cross-ploughing | — |
| | | (C) harrowing ... | ·24 hrs. |
| 10. | Fuel consumption in gallons per acre : | A—ploughing : a. kerosene | 5·44 gallons |
| | | b. petrol | ·36 ,, |
| | | c. oil | ·22 ,, |
| | | d. water | 2·58 ,, |
| | | B—cross-ploughing : a. kerosene, b. petrol, c. oil, d. water | only ½ acre was cross-ploughed and separate figures have not been calculated for this small area. |
| | | C—harrowing : a. kerosene | ·96 gallons |
| | | b. petrol | ·12 ,, |
| | | c. oil | ·1 ,, |
| | | d. water | 1·2 ,, |
| | | Water consumption high owing to burst connexion on first day resulting in total loss of water from radiator. | |
| | | | Rs. |
| 11 | Fuel cost per acre | A—ploughing ... | 10·70 |
| | | B—cross-ploughing ... | — |
| | | C—harrowing ... | 2·43 |
| 12 | Wages cost per acre | A—ploughing ... | 0·97 |
| | | B—cross-ploughing ... | — |
| | | C—harrowing ... | 0·12 |
| 13 | Total net cost per acre | A—ploughing ... | 11·67 |
| | | B—cross-ploughing ... | — |
| | | C—harrowing ... | 2·55 |
| 14 | Total gross cost per acre (net cost plus 20% on capital cost reckoning 250 working days of 8 hours per annum) | A—ploughing ... | 13·60 |
| | | B—cross-ploughing ... | — |
| | | C—harrowing ... | 2·90 |
| | | | acres. |
| 15 | Average acreage per hour | A—ploughing ... | ·51 |
| | | B—cross-ploughing ... | — |
| | | C—harrowing ... | 4·15 |
| 16 | Average quality of work performed : | A—ploughing | 70% |
| | | B—cross-ploughing | 70 ,, |
| | | C—harrowing | 75 ,, |
| 17 | Repairs or renewals :—Rubber canvas connexion of water conducting pipe burst. Seven cross bars and studs on wheels came out during trials owing to security nuts not being used. | | |
| | | | acres. |
| 18 | Areas ploughed and disced : | Ploughed ... | 4·15 |
| | | Cross-ploughed ... | ·5 |
| | | Harrowed ... | 4·15 |

## PLOT 3.—CLETRAC.

| | | | | |
|---|---|---|---|---|
| 1 | Name of Tractor—CLETRAC. | | | |
| 2 | Ceylon Agents—S. S. Sedgwick, The Watareka Mine, Padukka. | | | |
| 3 | Cost of Tractor, Colombo : | | | Rs. 6,850 |
| 4 | Cost of Implements, Colombo : Oliver D43, 3 disc plough ,, | | | 102 |
| | Double twenty disc harrow ,, | | | 1,105 |
| 5 | Weight of Tractor—3,455 lb. | | | |
| 6 | H. P. of Tractor—12—20 H. P. | | | |
| 7 | No. of furrows ploughed—3. | | | |
| 8 | No. of attendants—Driver and one assistant. | | | hours. |
| 9 | Time in hours per acre—(A) ploughing..... ..... | | | 1·45 |
| | (B) cross-ploughing..... | | | 2 |
| | (C) harrowing..... ..... | | | ·29 |
| 10 | Fuel consumption in gallons per acre. | | | gallons. |
| | A—ploughing | a. kerosene | | 2·4 |
| | | b. petrol | | ·022 |
| | | c. oil | | ·2 |
| | | d. water | | ·2 |
| | B—cross-ploughing | a. kerosene | | 2·1 |
| | | b. petrol | | ·09 |
| | | c. oil | | ·2 |
| | | d. water | | ·25 |
| | C—harrowing | a. kerosene | | 45 |
| | | b. petrol | | ·03 |
| | | c. oil | | ·05 |
| | | d. water | | ·17 |
| | | | | Rs. |
| 11 | Fuel cost per acre | A—ploughing | ... | 5·18 |
| | | B—cross-ploughing | ... | 4·85 |
| | | C—harrowing | ... | 1·11 |
| 12 | Wages cost per acre | A—ploughing | ... | 0·72 |
| | | B—cross-ploughing | ... | 1·00 |
| | | C—harrowing | ... | 0·15 |
| 13 | Total net cost per acre | A—ploughing | ... | 5·90 |
| | | B—cross-ploughing | ... | 5·85 |
| | | C—harrowing | ... | 1·26 |
| 14 | Total gross cost per acre: (Net cost plus 20% on capital cost reckoning 250 working days of 8 hours per annum) | A—ploughing | ... | 7·04 |
| | | B—cross-ploughing | ... | 7·41 |
| | | C—harrowing | ... | 1·49 |
| 15 | Average acreage per hour : | | | acres. |
| | | A—ploughing | ... | ·69 |
| | | B—cross-ploughing | ... | ·5 |
| | | C—harrowing | ... | 3·45 |
| 16 | Average quality of work performed | | | % |
| | | A—ploughing | ... | 80 |
| | | B—cross-ploughing | ... | 90 |
| | | C—harrowing | ... | 95 |
| 17 | Repairs or renewals | Nil. | | |
| 18 | Total area ploughed and harrowed | | | acres. |
| | | 1. ploughed | ... | 4·3 |
| | | 2. cross-ploughed | ... | 2·7 |
| | | 3. harrowed | ... | 4·3 |

AVERY.



FORDSON

## PLOT 4—AVERY.

| | | | | | |
|---|---|---|---|---|---|
| 1 | Name of Tractor : | AVERY | | | |
| 2 | Ceylon Agents : | Colombo Stores, Ltd., Colombo. | | | Rs. |
| 3 | Cost of Tractor, Colombo : | | | ... | 4,500 |
| 4 | Cost of implements, Colombo : | 2–Furrow Grand Detour plough 12 inch cut | | | 900 |
| | | Double ten disc-harrow | | | 600 |
| 5 | Weight of Tractor : | 3,150 lb. | | | |
| 6 | H. P. of Tractor : | 7—14 H. P. | | | |
| 7 | No. of furrows ploughed : | 2 | | | |
| 8 | No. of attendants : | Driver and one assistant. | | | hours |
| 9 | Time in hours per acre | Ploughing | | | 4·1 |
| | | Cross-ploughing | | | 1·10 |
| | | Harrowing | | | 1·00 |
| 10 | Fuel consumption in gallons: | | | | gallons |
| | | A—ploughing : | a. | kerosene | nil |
| | | | b. | petrol | 5·2 |
| | | | c. | oil | ·37 |
| | | | d. | water | ·5 |
| | | B—cross-ploughing | a. | kerosene | nil |
| | | | b. | petrol | 2 |
| | | | c. | oil | ·37 |
| | | | d. | water | ·5 |
| | | C—harrowing | a. | kerosene | nil |
| | | | b. | petrol | 1 |
| | | | c. | oil | ·18 |
| | | | d. | water | ·5 |
| | | | | | Rs. |
| 11 | Fuel cost per acre : | A—ploughing | | ... | 12·47 |
| | | B—cross-ploughing | | ... | 6·39 |
| | | C—harrowing | | ... | 3·20 |
| 12 | Wages cost per acre : | A—ploughing | | ... | 2·00 |
| | | B—cross-ploughing | | ... | 0·55 |
| | | C—harrowing | | ... | 0·50 |
| 13 | Total net cost per acre : | A—ploughing | | ... | 14·47 |
| | | B—cross-ploughing | | ... | 6·94 |
| | | C—harrowing | | ... | 3·70 |
| 14 | Total gross cost per acre : (net cost plus 20% on capital cost reckoning 250 working days of 8 hours per annum) | A—ploughing | | ... | 15·76 |
| | | B—cross-ploughing | | ... | 7·43 |
| | | C—harrowing | | ... | 4·20 |
| 15 | Average acreage per hour | | | | acres. |
| | | A—ploughing | | ... | ·24 |
| | | B—cross-ploughing | | ... | ·9 |
| | | C—harrowing | | ... | 1·00 |
| 16 | Average quality of work performed: | A—ploughing | | ... | 45% |
| | | B—cross-ploughing | | .. | 50% |
| | | C—harrowing | | ... | 65% |
| 17 | Repairs and renewals: | Nil—air washer damaged against tree during ploughing. | | | |
| 18 | Area ploughed and cross ploughed | | | | acres. |
| | | A—ploughed | | ... | 1·91 |
| | | B—cross-ploughed | | ... | 1·00 |
| | | C—harrowed | | ... | 1·00 |

## PLOT 5—FORDSON.

| | | | | | |
|---|---|---|---|---|---|
| 1 | Name of Tractor : | FORDSON. | | | |
| 2 | Ceylon Agents : | Messrs. Brown & Co., Colombo. | | | |
| 3 | Cost of Tractor, Colombo : | | | Rs. | 4,000 |
| 4 | Cost of implements : | 2-furrow plough .. | | Rs. | 875 |
| | | Double twelve disc-harrow | | Rs. | 775 |
| 5 | Weight of Tractor : | 2,700 lb. | | | |
| 6 | H. P. of Tractor : | 22 h.p. | | | |
| 7 | Number of furrows ploughed : | 2 | | | |
| 8 | Number of attendants: | Driver and one assistant. | | | hours. |
| 9 | Time in hours per acre : | A—ploughing | | | 1·76 |
| | | B—cross-ploughing | | | ·58 |
| | | C—harrowing | | | ·44 |
| 10 | Fuel consumption in gallons per acre : | | | | gallons. |
| | | A—ploughing: | a. kerosene | | 1·72 |
| | | | b. petrol | | ·03 |
| | | | c. oil | | ·12 |
| | | | d. water | | ·57 |
| | | B—cross ploughing | a. kerosene | | 2·5 |
| | | | b. petrol | | ·03 |
| | | | c. oil | | ·12 |
| | | | d. water | | ·57 |
| | | C—harrowing | a. kerosene | | ·52 |
| | | | b. petrol | | ·03 |
| | | | c. oil | | ·12 |
| | | | d. water | | ·5 |
| | | | | | Rs. |
| 11 | Fuel cost per acre : | A—ploughing | ... | | 3·57 |
| | | B—cross-ploughing | ... | | 4·80 |
| | | C—harrowing | ... | | 1·71 |
| 12 | Wages cost per acre: | A—ploughing | ... | | 0·88 |
| | | B—cross-ploughing | ... | | 0·29 |
| | | C—harrowing | ... | | 0·22 |
| 13 | Total net cost per acre : | A—ploughing | ... | | 4·45 |
| | | B—cross-ploughing | ... | | 5·09 |
| | | C—harrowing | ... | | 1·93 |
| 14 | Total gross cost per acre : (Net cost plus 20% on capital cost reckoning 250 days of 8 hours per annum) | A—ploughing | ... | | 5·31 |
| | | B—cross-ploughing | ... | | 5·37 |
| | | C—harrowing | ... | | 2·15 |
| 15 | Average acreage per hour : | | | | acres. |
| | | A—ploughing | ... | | ·57 |
| | | B—cross-ploughing | ... | | 1·73 |
| | | C—harrowing | ... | | 2·3 |
| 16 | Average quality of work performed : | A—ploughing | ... | | 20% |
| | | B—cross-ploughing | ... | | 30% |
| | | C—harrowing | ... | | 45% |
| 17 | Repairs and renewals : | Nil | | | |
| 18 | Total area ploughed and harrowed : | | | | acres. |
| | | 1. Ploughed | ... | | 4·25 |
| | | 2. cross-ploughed | ... | | 1·17 |
| | | 3. harrowed | ... | | 2·97 |

BUFFALOS PLOUGHING ALONGSIDE TRACTOR TRIAL PLOTS.

# CEYLON AGRICULTURE.

## REPORT ON THE PADDY MANURING EXPERIMENTAL PLOTS.

M. KELWAY BAMBER, M.R.A.C., F.I.C., F.C.S.
*Agricultural Chemist.*

### FOR THE MAHA SEASON, 1920 AND 1921.

These paddy manuring trials were carried out owing to the urgent necessity of increasing food production. Funds were provided from sums voted to the Food Production Department for experiments. They were carried out under the immediate supervision of Agricultural Instructors on plots selected by the Agricultural Chemist to the Department of Agriculture after personal inspection. With the appointment of Divisional Agricultural Officers to the Central, Southern and Northern Divisions the general supervision of the experimental areas was transferred to these officers.

The chief object was to try and demonstrate to the villager the effect of artificial manures, green manuring and better cultivation of the soil on the growth and yield of paddy,

At the time Bone Meal, the manure chiefly used for paddy, was very expensive and practically unobtainable, and the export from India was liable to be stopped.

The only other phosphatic manure imported at a reasonable rate was Ephos Phosphate with properties somewhat similar to Basic Slag, and it was decided to try this as compared with Bone Meal.

In view of the possible manufacture of Nitrolim in Ceylon in the future, this manure was also tried in one mixture together with Phosphates in the form of Ephos Phosphate and Fish Guano. Nitrolim supplies the cheapest unit of Nitrogen and from its decomposition in the soil, with formation of urea and ammonia, it was considered suitable for paddy manuring.

Sites were selected in all the districts in Ceylon for the Maha crop. Considerable difficulty was experienced in obtaining 4 acres of uniform soil in one block owing to the small areas owned by different people, and the great variation in yields even in the same block of fields. In some districts the cultivation and application of manures depended on rainfall which in some cases was several weeks late resulting in short-period paddy having to be grown instead of the 5 to 7 months paddy usually grown in the Maha season. This gave little time for the manures to act and at the same time possible changes in the mixtures may have taken place, especially as regards the nitrolim.

The expenditure on paddy manuring with bone meal rarely exceeded Rs. 10 per acre and was generally much less—the usual application being from ½ to 1 cwt. per acre, costing pre-war Rs. 3·50 per cwt. Such application is very small compared with normal applications to cereal crops in other countries, and it is probable that larger amounts would give better results. It was thought necessary, however, to maintain the cost as low as possible so as to be within the reach of the villager.

The ordinary methods of cultivation adopted in each district were carried out by the local cultivators but with more thoroughness and the manures applied under the supervision of the Agricultural Instructors.

Local varieties of paddy chosen by the cultivators as most suitable for the district were grown.

The instructions issued to the Agricultural Instructors and cultivators were as follows :—

All work including ploughing, digging and mudding or levelling to be thoroughly done, also at least one weeding when the paddy is from 4 to 6 weeks old.

The manures before application to be mixed with their bulk of dry soil, and broadcasted over the plot *after* the second ploughing or digging and *before* the mudding or levelling.

Careful records of dates of cultivation and application of manures, etc., to be kept, also monthly notes on rainfall and the condition of the plots.

At harvesting the crop from each plot to be stacked and thrashed separately under the supervision of the Agricultural Instructors and complete records of the yields of paddy and straw to be taken.

The next yala crop to be taken on the same area without additional manure and similar records obtained.

The plots were to be approximately one acre each but accurate measurements could not be obtained owing to the shape and number of the different "Liaddas" and bunds in each area. The areas could only be computed by pacing and the record of sowing extent by which areas were gauged in each district.

The actual sowing extent was generally obtained from the actual cultivators of the plots in question.

The sites selected were all adjacent to main or village roads where they could be observed and inspected and represented considerable areas of paddy land.

Most of the plots were labelled giving the different manures employed in each case.

The plan of manuring in each station was as follows :—

*Plot 1.* Green manure at one ton per acre and Ephos Phosphate 1 cwt. per acre.

*Plot 2.* Mixture "A" consisting of Nitrogen and Phosphates without Potash.

| | | | | |
|---|---|---|---|---|
| Fish Guano | 84 lb. | Containing Nitrogen | | 11·4 lb. |
| Ephos Phosphate | 100 ,, | ,, | Phosphoric Acid | 34·2 ,, |
| Nitrolim | 40 ,, | | | |
| | 224 lb. per acre | | | |

Costing approximately Rs. 16·75 per acre in Colombo.

*Plot 3.* Mixture "C" an organic manure containing Nitrogen, phosphoric Acid and Potash.

| | | | | |
|---|---|---|---|---|
| Sterilised Animal Meal | 112 lb. | Containing | Nitrogen | 10·1 lb. |
| Std. Bone meal | 56 ,, | ,, | Phos. Acid | 20·7 ,, |
| | | | Potash | 6·3 ,, |
| | 168 lb. per acre. | | | |

Costing approximately Rs. 15·50 in Colombo

This mixture was presented free of cost by MESSRS. SHAW WALLACE & CO., Colombo.

*Plot 4.* Control, no manure.

The arrangement of the plots varied, but the control was placed at the higher level where it first received the irrigation water, so that the manures would not be carried into lower plots.

In some cases it was found that the crop on the control plot was better than those below owing to the silt carried on in the irrigation water.

This was not observable when the sites were selected on the bare land.

For the green manure plot any suitable green manure available locally was to be used, such as Dadap, Suriya, Keppitiya, Tephrosia, Ingasaman, etc. The leaves and small branches were spread over the plot before ploughing and well worked into the soil, the phosphate being applied before the second ploughing and mudding.

In some cases there was delay in the manures reaching their destination owing to difficulties of transport.

In others the application was delayed owing to the lateness of the North-East Monsoon, and in some instances considerable damage was done by heavy floods when the monsoon burst, the manure and growing crop being washed away and having to be re-sown with a short-age paddy.

The methods of cultivation varied considerably in the different districts.

In the Kandy districts two ploughings are usually given followed by mudding with buffalos and by hand. In the swamp districts only mudding is done by buffalos and the surface levelled by hand.

In the Northern Province the land is ploughed after the North-East rains begin about October, then dug with mamoties and mudded.

In parts of the Sabaragamuwa and Southern provinces, the soil is dug twice and then mudded.

The yield from the various plots are summarised for each district.

## CENTRAL DIVISION.

G. HARBORD, Acting Divisional Agricultural Officer.

### KANDY DISTRICT.

*Hindagala.*—Agricultural Instructor—the late MR. D. B. HINDAGALA.

The plots of approximately half an acre each were sown in October, 1920, and harvested in March, 1921. Variety used Muttusamba, 6 months paddy.

| Plot | Manure | Yield per acre. grain | straw. |
|---|---|---|---|
| 1 | Green manure | 93½ bus. | 2,800 lb. |
| 2 | Mixture "A" | 30 ,, | 2,000 ,, |
| 3 | Cattle manure | 39 ,, | 800 ,, |
| 4 | Control | 26 ,, | 1,600 ,, |

Plot 1 was reported on as of excellent growth the height of the paddy being 4 ft. to 5 ft. For Plot 3, only 4 cart-loads of cattle manure were applied. The increase of the manured plots over the unmanured is satisfactory, especially the green manure and Ephos Phosphate plot.

*Mahaiyawa*: These plots were approximately half acre each and were grown with Hatial variety, transplanted with 2 or 3 plants 4 to 5 inches apart.

| Plot | Manure | Yield per acre bushels. |
|---|---|---|
| 1 | Green Manure 1,000 lb. and Ephos ¾ cwt. | 41 |
| 2 | Mixture "A" (1 cwt.) | 37 |
| 3 | ,, "C" (1 ,, ) | 36 |
| 4 | ,, Control | 33 |

The manured plots gave an increase of 3 and 4 bushels per acre and the green manure and Ephos plot an increase of 8 bush. per acre. Dadap and wild sunflower were applied as green manure.

*Yatawara.*—Agricultural Instructor, Mr. W. Molegode. There were only three plots of ½ acre each, sown with Hatial a 5 months paddy.

| Plot. | Manure. | Yield per acre bushels. |
|---|---|---|
| 1 | Green manure 1000 lb. and ¾ cwt. Ephos ... | 42 |
| 2 | "A" Mixture ... ... .. | 38 |
| 3 | Control ... ... ... | 36 |

*Gannoruwa.*—Three areas of one acre each were planted with Hatial variety (6 months).

*Plot 1* manured with green manure (Dadap, wild sunflower, etc.) and 100 lb. Ephos Phosphate, costing about Rs. 12 per acre.

*Plot 2* manured with bone meal 100 lb. and nitrolim 50 lb. costing Rs. 13·39 per acre.

*Agricultural School, Peradeniya.*—Four plots were transplanted with Hatial variety of paddy on the 4th and 5th September, 1920, and harvested on the 15th February, 1921.

| Plot. | Area. | Manure per acre. | Yield per acre. Paddy. | Straw. |
|---|---|---|---|---|
| 1 | 1/6 acre | Control | 48⅜ bus. | — |
| 2 | 1/3 ,, | Control | 32¼ ,, | 2046 lb. |
| 3 | 1/5 ,, | General mixture 1½ cwt. | 42½ ,, | 2690 ,, |
| 4 | 2/9 ,, | ,, ,, 3 ,, | 40½ ,, | 2731 ,, |

The first Control of 1/6 acre was situated near the irrigation inlet, which was taken from a ravine draining the Rubber Estate above, was more closely planted than the other three fields. The tillering and growth on all the plots was good, and especially on the two manured plots. The application of 1½ cwt. of general mixture with Nitrolim gave an increase of 10 bushels of paddy and 644 lb. straw per acre over the Control plot C.

The doubling of the application to 3 cwt. per acre gave rather less increase of paddy, viz., 8¼ bushels, but increased the straw by 685 lb. of straw per acre.

## MATALE DISTRICT.

*Ukuwela.*—One plot of 3 roods and 8 poles was manured with green manure and Ephos Phosphate and transplanted with Mawi variety.

| Plot. | Manure. | Yield per acre. bushels. |
|---|---|---|
| 1 | Green Manure & Ephos ... | 50 |
| 2 | Control (Previous yield) ... | 35 |

*Halangoda.*—One plot of 1 acre was manured with general mixture "A" Sown broadcast with Hondarawala paddy.

| Plot. | Manure. | Yield per acre. bushels. |
|---|---|---|
| 1 | Mixture "A" ... | ... $33\frac{1}{2}$ |
| 2 | Control (Previous yield) ... | ... $20\frac{3}{4}$ |

*Kalalpitiya.*—One plot of 3 roods and 31 poles manured with mixture "C" sterilised animal meal 112 lb. and Bone Meal 56 lb. and sown broadcast with Hondarawala paddy.

| Plot. | Manure. | Yield per acre. bushels. |
|---|---|---|
| 1 | Mixture "C" .... | ... 38 |
| 2 | Control (previous yield) ... | ... 20 |

Single plots were manured with a mixture consisting of 20 lb. Nitrolim, 20 lb. Fish Manure and 128 lb. of Ephos Phosphate or 168 lb. at Weyalamune, Pambadeniya, Totagamuwa, Weragama (2 plots) and Matale Town.

| Plot. | Area. | Variety of Paddy. | How Planted. | Yield per acre. bush. | Previous yield Control. Bush. per acre. |
|---|---|---|---|---|---|
| Weyalamune | - $\frac{1}{2}$ acre | Hatial | Broadcasted | 46 | 55 |
| Pambadeniya | - $\frac{1}{2}$ ,, | Hatial | Broadcasted | 30 | 25 |
| Totagamuwa | - 2 ,, (nearly) | Honda-rawala | Transplanted | 33 | 48 |
| R. M.'s land Weragama | - 1 acre | Mawi | Broadcasted | 32 | 40 |
| Korala's Weragama | - $\frac{3}{4}$ ,, | Mawi | Broadcasted | 63 | 69 |
| Matale Town | - $\frac{3}{4}$ ,, | Mawi | Transplanted | 27 | 25 |

## KEGALLE DISTRICT.

Agricultural Instructor, MR. C. P. CRISPEYN. These plots of about half an acre each were sown with Hondarawala paddy.

*Dedigama.*

| Plot. | Manure. | Yield per acre. |
|---|---|---|
| 1 | Green manure and Ephos Phosphate ... | 25 bushels |
| 2 | Mixture "A" ... ... | 32 ,, |
| 3 | ,, "C" ... ... | 54 ,, |
| 4 | Control ... ... | 20 ,, |

The growth on all the plots was even and the yield of the manured plots exceed the control and especially the mixture of $1\frac{1}{2}$ cwt. of sterilised animal meal and Bone Meal. Owing to want of time no green manure was applied to Plot 1 but the nitrolim mixture gave satisfactory results.

*Karandupona.*—The plots were half an acre each and were sown broadcasted with Hondarawala variety.

| Plot. | Manure. | Yield per acre. |
|---|---|---|
| 1 | Green manure ... ... | 28 bushels |
| 2 | Mixture "A" ... ... | 40 ,, |
| 3 | ,, "C" ... ... | 70 ,, |
| 4 | Control ... ... | 20 ,, |

In these plots the sterilised animal meal mixture again gave the best results with an increase of 50 bushels per acre over the control. The Nitrolim mixture "A" also gave a satisfactory increase. The quantity of green manure applied, if any, has not been stated.

*Beligammana.*--These plots were half acre each and transplanted with Mawi variety.

| Plot. | Manure. | Yield per acre. |
|---|---|---|
| 1 | Cattle manure 3 cwt. and Ephos 1 cwt. | 60 bushels |
| 2 | Mixture "A" ... ... | 65 ,, |
| 3 | ,, "C" ... ... | 50 ,, |
| 4 | Control ... ... | 46 ,, |

Plot 1 received 3 cartloads of cattle manure and 1 cwt. of Ephos Phosphate and gave an increase of 14 bushels per acre. The yield from the Nitrolim mixture was also satisfactory, while the sterilised animal meal had less effect than in the other plots.

All the plots were badly laid about 1½ months before reaping.

*Andimada.*—Plots of ½ acre each broadcasted with Hondarawala paddy.

| Plot. | Manure. | Yield per acre |
|---|---|---|
| 1 | Green manure ... ... | 40 bushels |
| 2 | Mixture "A" ... ... | 32 ,, |
| 3 | ,, "C" .. ... | 36 ,, |
| 4 | Control ... .. | 20 ,, |

For the green manure plot only 1 cwt. Mikania scandens and straw was applied together with 1 cwt. Ephos Phosphate.

The results are satisfactory on all the manured plots over the Control or unmanured. The growth was even and especially heavy on the animal meal plot. None of the plots were layered with the rains.

*Paragammana.*—The plots were about ½ acre each and were sown broadcast with Sudu Hatial Paddy.

| Plots. | Manure. | Yield per acre. |
|---|---|---|
| 1 | Green manure ... ... | 16½ bushels |
| 2 | Mixture "A" ... ... | 14 ,, |
| 3 | ,, "C" ... ... | 14 ,, |
| 4 | Control ... ... | 10 ,, |

Plot 1 received 2 cwt. of Keppitiya leaves and straw and 1 cwt. Ephos Phosphate. The yields of the manured plots are better than the Control, but are all poor.

The growth on the green manure plot was best but generally was poor owing to very heavy rainfall after the manures were applied and the whole field being flooded.

## SOUTHERN DIVISION.

G. Auchinleck, M.Sc., Divisional Agricultural Officer.

### KALUTARA DISTRICT.

Plots under Agricultural Instructor, Mr. W. F. Seneviratne.

*Bandaragama.*—Four plots of about 1 acre each, sown with Hondarawala in October, 1920, and harvested in February, 1921.

| Plot. | Manure. | Yield per acre. |
|---|---|---|
| 1 | Control ... | 19⅛ bushels. |
| 2 | Mixture "A" ... | 26⅜ ,, |
| 3 | Mixture "C" ... | 34⅛ ,, |
| 4 | Green Manure "B" ... | 18 1/5 ,, |

Both the nitrolim and sterilised animal meal mixtures gave satisfactory increases. While the green manure plot is unsatisfactory, there is no record of the amount of green leaves etc., applied.

*Horana.* Four plots of 1 acre each sown with Podi-ratawi variety, in October, 1920, and harvested in February, 1921.

| Plot. | Manure. | | Yield per acre. |
|---|---|---|---|
| 1 | Control | ... | 24⅛ bushels. |
| 2 | Mixture "C" | ... | 22⅜ ,, |
| 3 | Green Manure "B" | ... | 24 ,, |
| 4 | Mixture "A" | ... | 36 ,, |

The nitrolim mixture gave the best results with an increase of 12 bushels or 50 per cent. over the control plot. The sterilised animal meal gave no increase, nor did the green manure.

## GALLE DISTRICT.

Agricultural Instructor, MR. GEO. SENEVIRATNE.

*Uluvitike.* Four plots of one acre each, planted with Karayal variety in October, 1920, and harvested in February, 1921.

| Plot. | Manure. | | Yield per acre. |
|---|---|---|---|
| 1 | Control | ... | ½ bushel. |
| 2 | Green Manure | ... | 13 1/6 ,, |
| 3 | Mixture "C" | ... | 16 ,, |
| 4 | Mixture "A" | ... | 7 ,, |

Although the manured plots, especially mixture "C" with potash, gave a large increase over the Control, the total yields were very poor. The Nitrolim mixture was unsatisfactory.

*Kodagoda.* Four plots of about 1 acre each sown with Bala Mahawee on 5th October, 1920, and reaped on 2nd February, 1921.

| Plot. | Manure. | | Yield per acre. |
|---|---|---|---|
| 1 | Control | ... | 4½ bushels. |
| 2 | Green Manure | ... | 17⅜ ,, |
| 3 | Mixture "A" | .. | 9⅜ ,, |
| 4 | Mixture "C" | ... | 10¼ ,, |

Green manure and Ephos gave the best results, followed by mixture "C" containing Potash. The Nitrolim mixture was unsatisfactory although the yield was over double that of the Control.

*Ganegama.* Four plots of 1 acre each sown with Bala Kuruwi variety on 3rd November, 1920, and harvested 15th February, 1921.

| Plot. | Manure. | | Yield per acre. |
|---|---|---|---|
| 1 | Control | ... | 21⅜ bushels. |
| 2 | Green Manure | ... | 13½ ,, |
| 3 | Mixture "A" | ... | 16¼ ,, |
| 4 | Mixture "C" | ... | 17¼ ,, |

In these plots the Control gave a higher yield than any of the manured plots and was possibly better soil.

*Akmimana.* One acre was sown with Ratawee Paddy and mixture "C" containing potash and gave a yield nearly of 34¼ bushels, compared with an average yield of 24 bushels per acre from the same plot previously.

## MATARA DISTRICT.

Experiments under Agricultural Instructor Mr. H. C. Peiris.

*Borala.* Four plots of about 1 acre each, sown with Balawi on the 20th October, and harvested on the 15th February, 1921.

| Plots. | Manure. | Yield per acre. |
|---|---|---|
| 1 | Green Manure ... | 10 1/16 bushels. |
| 2 | Mixture "A" ... | 11 1/16 ,, |
| 3 | Mixture "C" ... | 13 1/8 ,, |
| 4 | Control ... | 3 ½ ,, |

The Green manure plot received two cart loads of leaves and 1 cwt. Ephos. All the manured plots gave a considerable increase over the Control, but the total yields were poor.

*Sahabandu Kokmaduwa.* Four plots of nearly one acre each sown on the 1st October, 1920, and harvested on the 31st January, 1921.

| Plots. | Manure. | Yield per acre. |
|---|---|---|
| 1 | Green Manure | 21⅜ bushels. |
| 2 | Mixture "A" ... | 10¼ ,, |
| 3 | Mixture "C" ... | 14⅜ ,, |
| 4 | Control ... | 13¼ ,, |

The Green manure plot was satisfactory, but plot 2 was below the Control.

*Padili-Kokmaduwa.* Four plots of about one acre each sown on the 15th October, 1920, and harvested on the 9th February, 1921.

| Plots. | Manure. | Yield per acre. |
|---|---|---|
| 1 | Green Manure ... | 4 1/16 bushels. |
| 2 | Mixture "A" ... | 15 ½ ,, |
| 3 | Mixture "C" ... | 12 ¼ ,, |
| 4 | Control ... | 8 ¼ ,, |

The Nitrolim mixture gave the best results nearly double the Control. Plot and then the mixture with potash. The Green manure plot was very unsatisfactory.

In addition to the above plots, six plots adjoining schools in the Matara District were manured with the general mixture at about ½ cwt. per acre under the supervision of Agricultural Instructor, Mr. M. J. A. Karunanayake.

| Plots. | Area. | Manure. | Yield per Acre. | Variety. |
|---|---|---|---|---|
| Aturaliya | 1 acre | Mixture "A" ½ cwt. | 8½ bushels | Muttusamba |
| Puhulwila | ⅝ ,, | ,, ,, ,, ,, | 19½ ,, | ,, |
| Karandeniya | ¾ ,, | ,, ,, ,, ,, | 20 ,, | ,, |
| Thiagoda | 1½ acres | ,, ,, 1 cwt. | 23½ ,, | Duru-wee |
| Bopagoda | ⅝ ,, | ,, ,, ½ ,, | — | |

The Bopagoda plot was a failure, but the others are said to compare favourably with the adjoining fields.

*Thihagoda.* Four plots of 1 acre each were sown with Heendikwi on the 29th September, 1920, and harvested on 12th February, 1921.

| Plot. | Manure. | Yield per Acre. | Straw per Acre. |
|---|---|---|---|
| 1 | Mixture "C" | 13 bushels | 950 lb. |
| 2 | Green Manure | 7½ ,, | 475 ,, |
| 3 | Control | 4½ ,, | 280 ,, |
| 4 | Mixture "A" | 12¼ ,, | 755 ,, |

The yield of the whole of this tract was very poor this season and much below the usual standard. The mixtures "A" and "C" gave a considerable increase over the Control plot.

## HAMBANTOTA DISTRICT

Plots under Agricultural Instructor, MR. M. J. A. KARUNANAYAKE.

*Tissa.* Four plots of one acre each sown with Rath Karayal on the 14th November and harvested late in February.

| Plot. | Manure. | Yield per Acre. | Straw per Acre. |
|---|---|---|---|
| 1 | Mixture "C" | 24 bushels | 637 lb. |
| 2 | Green Manure | 24 ,, | 450 ,, |
| 3 | Mixture "A" | 36 ,, | 720 ,, |
| 4 | Control | 24 ,, | 460 ,, |

The Nitrolim mixture gave an increase of 50 per cent. over the Control in grain and over 56 per cent. in straw. The plants tillered fairly well and bore good ears. The Potash mixture and green manure gave no increase in grain but the plants in plot 1 tillered well and were more leafy.

*Hatagala.* Four plots of one acre each planted on the 29th November, 1920, and harvested on the 15th March, 1921.

| | | Yield per acre. | |
|---|---|---|---|
| Plot. | Manure. | Grain. | Straw, |
| 1 | Mixture "C" | 36⅛ bus. | 1,100 lb. |
| 2 | Green Manure | 42¼ ,, | 1,000 ,, |
| 3 | Mixture "A" | 24¼ ,, | 600 ,, |
| 4 | Control | 34⅛ ,, | 800 ,, |

The yield from the Nitrolim plot was unsatisfactory, the growth being poor and the green manure and Ephos Phosphate gave the best results with a gain of 8⅛ bushels grain and 200 lb. of straw per acre. On plot 1 the growth was leafy with good tillering, but the heads were poor.

On the green manure plot the plants grew to 5 feet with good heads.

*Lunawa.* Four plots of about 1 acre each sown with Rath-Karayal on the 29th November, 1920, and harvested on the 16th March, 1921.

| | | Yield per acre. | |
|---|---|---|---|
| Plot. | Manure. | Grain. | Straw. |
| 1 | Mixture "C" | 23¼ bus. | 700 lb. |
| 2 | Green Manure | 31¼ ,, | 800 ,, |
| 3 | Mixture "A" | 23¼ ,, | 600 ,, |
| 4 | Control | 30 ,, | 700 ,, |

Both mixtures gave yields below the Control Plot, and there was only slight increase in the green manure plot.

## NORTHERN DIVISION.

N. MARSHALL, Divisional Agricultural Officer.

## JAFFNA DISTRICT.

Agricultural Instructor, MR. K. C. PILLAI.

Plots were arranged at Yorkamputty, Anaikotta, Karunpotta, Chemanai and Vedukaddu.

Sowing of three varieties were done in September, 1920, and harvested late in February, 1921.

| | | | Yield per acre. | | Previous Yields. | |
|---|---|---|---|---|---|---|
| | Plots. | Manure. | Grain Bus. | Straw. | Grain Bus. | Straw. |
| 1 | Yorkamputty | Mixture "A" | 6 | ¼ cart-load | 30 | 1¾ cart-loads |
| 2 | Anaikottai | Mixture "C" | 13⅓ | ¾ ,, ,, | 36 | 1½ ,, |
| 3 | Karunpotta | Mixture "D" | Not harvested | | | |
| 4 | Chemanai | Mixture "D" | 36 | 2½ cart-loads | 30 | 2 ,, |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | Veddukadu | Mixture "D" | 40 | 2½ cart-loads | 36 | 2 | cart-loads |
| 6 | ,, | 1 cwt. Ephos phosphate | — | — | — | — | |
| 7 | ,, | Mixture "A" 1 cwt | — | — | — | — | |

*Plot 1.* The land was saline and the seedlings all scorched up within one month of sowing and application of manure. The plot was transplanted later.

*Plot 2.* Sown 9 days earlier, about half the plants died and transplanting was done later. The poor results are said to be due to the saline nature of the soil.

*Plot 3.* Manured with one cwt. of a soluble mixture one month after sowing. The seedlings are said to have germinated well, but died after the application of the manure.

*Plot 4.* Was sown five days earlier and manured with the same soluble mixture "D." It gave 36 bushels per acre, an increase of 6 bushels per acre over the previous yield.

*Plot 5.* Also manured with the soluble mixture "D" gave a yield of 40 bushels compared with 36 bushels previously.

*Plots 6 and 7.* The growing crop was carried away by floods, the land being newly taken up, and rather low and saline.

## VAVUNIYA DISTRICT.

MR. T. N. CHELLIAH'S field. Agricultural Instructor, MR. K. C. PILLAI.

Four plots of one acre each were sown broadcasted on 30th November, 1920, with Mutpangan variety of paddy and harvested on 15th April, 1921.

| Plot. | Manure. | Yield per acre. Grain. | Straw |
|---|---|---|---|
| 1 | General Mixture "A" | 32 bus. | 2 cart-loads. |
| 2 | Green manure and phosphate | 32 ,, | 2 ,, |
| 3 | General mixture "C" | 32 ,, | 2 ,, |
| 4 | Control | 30 ,, | 1¾ ,, |

No weeding was done, nor were blank spaces supplied with seedlings.

Mr. T. NAGAMUNI'S land. Three plots of 2 acres, 2½ acres and control 1 acre were broadcasted with Peria Vellai and Mutpangan varieties of paddy in late November and early December 1920, and harvested in April, 1921.

| Plot. | Paddy. | Manure. | Yield per acre. Paddy. | Straw. | Previous Yield. |
|---|---|---|---|---|---|
| 1 | Peria Vellai | General Mixture | 40 bus. | 2 cart-loads | 48 |
| 2 | Mutpangan | Top dressing mixture "D" | 30 ,, | 2 ,, | 30 |
| 3 | Peria Vellai | Control | 50 ,, | 2½ ,, | 50 |

No weeding was done. Soon after sowing the fields were under flood.

MR. M. K. MUDUKANDE'S land. Three plots of one acre each were broadcasted on the 10th December, 1920, with Senkarapen variety of paddy, and harvested on 28th April, 1921.

| Plot. | Manure. | Yield per acre. Paddy. | Straw. | Previous yield. |
|---|---|---|---|---|
| 1 | General Mixture "A" | 40 bus. | 2½ cart-loads | 32 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | Green Manure and Ephos phosphate | 36 bus. | | 2½ | cart-loads | 30 |
| 3 | Control | 30 | ,, | 2 | ,, | 30 |

The results are said to be fairly satisfactory.

## TRINCOMALIE DISTRICT.

Agricultural Instructor, MR A. C. CHELVANAYAGAM.

Four plots at Kottiar were sown with Oddaivalan variety on the 22nd November, 1920, and harvested on the 21st March, 1921. The plots had previously been sown with Murungan variety, on the 14th November, the manures having been applied on the 12th November. Heavy rain fell just after sowing and the plots were flooded. The land was again puddled and resown. In January the plots were again flooded by heavy rain and much damaged, many plants being killed so that results are inconclusive.

| Plot. | Manure. | | Yield per acre. Grain Bushels. |
|---|---|---|---|
| 1 | Mixture "A" | ... | 14 |
| 2 | Mixture "C" | ... | 13¼ |
| 3 | Green Manure (1 ton) | ... | 15½ |
| 4 | Control | ... | 16 |

The following plots were under the control of the Secretary, Ceylon Agricultural Society :—

## COLOMBO DISTRICT.

The plots in this district were under Agricultural Instructor, MR. A. B. ATTYGALLE.

*Halgampitiya.* Plots 1 acre each sown with Ratawee 4½ months paddy sown broadcast in November, 1920, and harvested in March, 1921.

| Plot. | Manure. | | Yield per acre. |
|---|---|---|---|
| 1 | Mixture "A" | ... | 4 3/8 bushels |
| 2 | Green Manure | ... | — ,, |
| 3 | Mixture "C" | ... | 11 ,, |
| 4 | Control | ... | 10 ,, |

These plots were very badly damaged by floods during the seedling stage being under water for one week, plot No. 2 was totally destroyed. The control plot was not damaged being above the flood level.

*Balhpitiya Plots.* Three plots of one acre each sown in October with Ratawee 4½ months variety.

| Plot. | Manure. | | Yield per acre. |
|---|---|---|---|
| 1 | Mixture "A" | ... | 12 bushels |
| 2 | Green Manure "B" | ... | 9 ,, |
| 3 | Control | ... | 6 ,, |

Previous yields are given as 6 bushels per acre and the Agricultural Instructor remarks that "considering the nature of the soil and previous yields the results are fair," but such yields would not pay for the manures,

*Henaratgoda.* Three plots of 1 acre each sown in November 1920 with Ratawee variety. These plots were totally destroyed by floods in the seedling stage.

## RATNAPURA DISTRICT.

Agricultural Instructor, MR. L. A. D. SILVA.

*Batugedera.*—Four plots of about 1 acre each sown broadcast with Madatawalu variety on the 21st November, 1920, and harvested on 9th March, 1921.

| Plot. | Manure | Yield per acre. Grain. | Straw. |
|---|---|---|---|
| 1. | Green manure, 12 cwt. ... | 20 Bus. | 1040 lb. |
| 2. | Mixture "A" ... | 26 ,, | 1344 ,, |
| 3. | ,, "C" ... | 16¼ ,, | 844 ,, |
| 4. | Control ... | 16 ,, | 832 ,, |

The crop grew well, but some damage was done by the Paddy fly pest. Both the Nitrolim mixture and green manure plots gave an increase over the unmanured plot, but the mixture with Potash, which did so well in the Kegalle district, gave no result.

*Balangoda.*—Mr. J. D. Nicholas, Agricultural Instructor.

Four Plots of about 1 acre each were sown broadcast with Mukalawi variety (5 months) on the 15—25th January, 1921. The plots were started late owing to the lateness of the Monsoon and were considerably damaged by floods soon after sowing, but were supplied with transplanted paddy.

Similar plots were started at Pallokandewasama, but have not yet been harvested. The Agricultural Instructor reports a marked difference between the Control and manured plots, and that the crop suffered from insufficient water during the second month.

## BATTICALOA DISTRICT.

Agricultural Instructor, Mr. N. Thambiah.

Mulupalai under Pattipalai aru scheme. Four plots of ½ acre each were sown broadcasted with Perunel variety of paddy on 30th December, 1920, and harvested on 30th March, 1921.

| Plot. | Manure. | Yield per acre. Grain. | Straw. | Previous yield. |
|---|---|---|---|---|
| 1. | Green manure 1200—1500 lb. and ½ cwt. Ephos Phosphate | 22 bus. | 504 lb. | 15—18 bushels |
| 2. | Mixture C ¾ cwt. ... | 16½ ,, | 448 ,, | ,, ,, |
| 3. | ,, A 1 ,, ... | 15 ,, | 336 ,, | ,, ,, |
| 4. | Control ... | 15½ ,, | 392 ,, | ,, ,, |

The quantity of seed paddy used was 2½ bushels as against 3¾ bushels previous season. The plots were weeded once. The plots were on high land and were uneven. Past results were always poor. The Green manure and Ephos Phosphate plot gave the best result with an increase of 6½ bushels paddy and 112 lb. of straw.

*Sengalpaddai.*—These were of ½ acre each and broadcasted with Perunel variety of paddy on 12th February, 1921, and harvested on 12th May, 1921.

| Plot. | Manure. | Yield per acre. Grain. | Straw. | Previous yield. |
|---|---|---|---|---|
| 1 | Green manure 1200 to 1500 lb. (Kayan leaves) and ½ cwt. Ephos Phosphate ... | 22 bus. | 448 lb. | 18—23 bushels |
| 2 | Mixture C ¾ cwt. ... | 16½ ,, | — | ,, ,, |
| 3 | ,, A 1 ,, ... | 15 ,, | — | ,, ,, |
| 4 | Control ... | 21 ,, | — | ,, ,, |

The selected field was in a low land. Soil fairly good, but the Agricultural Instructor reports that the manure may have been washed by the rains to the other plots. Plot 1 showed fair growth. One weeding was given. The mixtures did not do well on these plots, but green manure and phosphate gave a slight increase.

*Pullumalai.*—Plots of ½ acre each were broadcasted with Perung Karuppen variety of paddy on 12th January, 1921, and harvested on 24th March, 1921.

| Plot. | Manure | Yield per acre. Grain. | Straw. | Previous yield. |
|---|---|---|---|---|
| 1 | Green manure (1200—1500 lb.) and ½ cwt. Ephos Phosphate | 30 bus. | 644 lb | 14—16 bushels |
| 2 | Mixture C ¾ cwt. ... | 25 ,, | 388 ,, | ,, ,, |
| 3 | ,, A 1 ,, ... | 16 ,, | 336 ,, | ,, ,, |
| 4 | Control ... | 18 ,, | 364 ,, | ,, ,, |

The selected fields were under Pullumalai Tank, the soil being poor and of a sandy loam. Results were promising especially in Plot 1. A cyclone during January did some damage. The plots were weeded once.

The green manure and Phosphate plot gave an increase of 12 bushels of paddy and 280 lb. of straw. Mixture C containing potash also gave a fair increase of 7 bushels of paddy per acre and slightly more straw.

## BADULLA DISTRICT.

Agricultural Instructor MR. J. A. RAMBUKPOTA.

Two plots of half an acre each in Badulla were sown with two varieties of paddy Murungawi and Kalabawi 6 months and 4 months respectively and manured with mixtures containing Nitrolim and Phosphates. The Murungawi was transplanted on the 25th August, 1920, and harvested on the 8th February, 1921, and the Kalabawi broadcasted on the 8th October, 1920, and harvested 28th January 1921.

| Plot. | Manure used per acre. | | Yield per acre. Grain Bus. | Straw bundles. | Previous yields. Grain Bus. | Straw bundles. |
|---|---|---|---|---|---|---|
| | Fish guano | 70 lb. | | | | |
| | Ephos | 100 ,, | 32 | 300 | 20 | 250 |
| 1 | Nitrolim | 18 ,, | | | | |
| | | 188 lb. | | | | |
| | Bone Dust | 120 lb. | | | | |
| 2 | Nitrolim | 24 ,, | 20 | 250 | 14 | 200 |
| | | 144 lb. | | | | |

## CHILAW DISTRICT.

One acre was manured with the Mixture "C" containing Potash, but the crop was washed away by rain. The four plots under the supervision of MR. R. CHELVADURAI PROCTOR, were also destroyed by flood.

### SUMMARY.

The results of the paddy manuring experiments have been rather erratic, especially in the Northern and North-Central Provinces. As a rule, but not invariably, the mixture "A" consisting of Fish Guano, Ephos Phosphate and Nitrolim has not given satisfactory results, which may have been due to the Nitrolim 40 lb. per acre having in some cases undergone some change on keeping with production of dicyanamide, which is poisonous to plants. Some of the plots manured with the mixture "A" gave considerable increases over the unmanured plots, the average being shown under mixure "A."

The green manure plots with 1 cwt. of Ephos Phosphate have been generally satisfactory although in several cases the quantity of one ton per acre was not applied.

The increases in the various districts were as follows :—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Kandy | District. | increase. | 6 to 67 | bushels. | average | 27 | bushels. |
| Kegalle | ,, | ,, | 4 to 20 | ,, | ,, | $8\frac{3}{4}$ | ,, |
| Colombo | ,, | | | | ,, | 3 | ,, |
| Galle | ,, | ,, | −8 to + 13 | ,, | ,, | 9 | ,, |
| Matara | ,, | ,, | −4 to + 8 | ,, | ,, | $3\frac{3}{4}$ | ,, |
| Hambantota | ,, | ,, | 1 to 8 | ,, | ,, | 3 | ,, |
| Ratnapura | ,, | | | | ,, | 4 | ,, |
| Batticaloa | ,, | ,, | 7 to 12 | ,, | ,, | $9\frac{1}{2}$ | ,, |

Both Kalutara and Trincomalie showed no increase but in the latter case the crop was twice damaged by flood.

Green manuring at one ton per acre is said to cost from Rs. 4 to Rs. 6 for collecting and carrying to the field, while the one cwt. of Ephos Phosphate cost about Rs. 6 or from Rs. 10 to Rs. 12 per acre in all.

Most cultivators are already aware of the value of green manuring and it is largely practiced in some districts, chiefly by cutting branches and leaves of surrounding trees and shrubs and applying to the soil before ploughing. The leaves employed include Dadap, Ingasaman, Keppitiya, Kekuna, etc. Where small areas of paddy lands are surrounded by gardens or hill slopes sufficient green manure can sometimes be obtained, but for large areas such as occur in the Southern Province, Batticaloa, Trincomalie and the North and North-Central Provinces, green manures except for a few acres are not obtainable. In such areas green manures can only be grown on the soil itself between the paddy growing seasons.

In Jaffna, *Crotalaria Juncea* is largely grown and other green manures being tried are, Daincha, *Sesbania Aculeata* ; "Pila," *Tephrosia Purpurea* and similar crops.

Daincha is largely used in India, but Pila is probably more suitable for Ceylon, and large quantities of seed could be obtained from the Central and other Provinces where it is very prevalent. The collection of such seed is strongly recommended.

All waste lands adjoining paddy fields should be planted up with leguminous plants such as Dadap, Gliricidia, *Tephrosia candida*, *Casia auriculata* and other annuals or perennials capable of yielding large quantities of green material for carrying on to the adjacent fields.

**MIXTURE "A."**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Kandy | District | increase | 2 — 4 | bus. | Average | 3 | 1/3 | bus. |
| Kegalle | ,, | ,, | 4 — 20 | ,, | ,, | 11 | 1/3 | ,, |
| Colombo | ,, | ,, | 6 | ,, | ,, | 6 | | ,, |
| Kalutara | ,, | ,, | $7\frac{1}{4}$ – 12 | ,, | ,, | $9\frac{1}{2}$ | | ,, |
| Galle | ,, | ,, | −5 to + 6 | ,, | ,, | $\frac{3}{4}$ | | ,, |
| Matara | ,, | ,, | −3 to + 8 | ,, | ,, | 4 | | ,, |
| Hambantota | ,, | ,, | −7 to + 12 | ,, | ,, | 1 | | ,, |
| Ratnapura | | | | | ,, | 10 | | ,, |
| Batticaloa | ,, | ,, | $-\frac{1}{2}$ to − 2 | ,, | ,, | $-1\frac{1}{4}$ | | ,, |
| Badulla | ,, | ,, | 8 to −12 | ,, | ,, | +10 | | ,, |
| Jaffna | ,, | | | | | | | |
| Trincomalie | ,, | | | | | − 2 | | ,, |

The mixture appears unsuitable for Hambantota, Galle, Batticaloa, Trincomalie and Jaffna.

Mixture "C" consisting of sterilised animal meal and Steamed bone meal gave fair results in several districts, especially, Kandy, Kegalle, Kalutara, Matara, Hambantota and Batticaloa.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Kandy | District increase | | 3 to 50 | bushels. | Average | 29 | bushels |
| Kegalle | ,, | ,, | 4 to 16 | ,, | ,, | 8 | ,, |
| Kalutara | ,, | ,, | −2 to 16 | ,, | ,, | 7 | ,, |
| Matara | ,, | ,, | +1 to 10 | ,, | ,, | 5 | ,, |
| Hambantota | ,, | ,, | nil to 9 | ,, | ,, | 3 | ,, |
| Batticaloa | ,, | ,, | 1 to 7 | ,, | ,, | 4 | ,, |

The other districts gave poor results, partly due to floods or drought.

Several paddy soils have been analysed from the plots and the following are given to show the variation in character of the soil in the same paddy area.

The samples were taken from the Gannoruwa village lands.

No. 1. One acre of rich land giving 70 to 80 bushels per acre and up to 100 bushels per acre for Maha and 50 to 60 bushels per acre for the Yala Crop.

No. 2. One acre of poorer land slightly higher than No. 1 plot giving 40 to 50 bushels for the Maha and 25 to 30 bushels for the Yala Crop.

Neither areas have ever been manured and irrigation is from a stream running down the valley, where there is no tea or other manured estate.

No. 1. is a brown loam soil in a fine state of division, the fine material containing 18% of clay 31% of fine silt and 14% of silt. There is no coarse gravel and the sand and fine gravel amounts to 27 per cent. The retentive power for water is high 73%.

The soil is fairly rich in humus, nitrogen and mineral plant food generally, which latter is largely derived from decomposing mica.

No. 2 is a brown gravelly loam, the fine material consisting of 5·50% clay, 10% fine silt, and 8% silt. A total of 23% against 63% in No. 1. The coarser material consists of coarse and fine gravel and sand, amounting to 77% which reduces the water retention power to 45% against 73% in the better soil. The humus, Nitrogen and mineral plant food is generally lower than in No. 1 and comparing the relative amounts of finer material on which the figures are based. The contrast is greater than indicated by the Analysis. The proportion of available phosphoric acid and Potash is however slightly higher in No. 2.

## ANALYSIS.

The marked difference in the mechanical composition and water retaining capacity of the two soils would largely account for the different yields obtained. It serves to indicate the necessity of thorough cultivation and mudding of all paddy soils to retain the maximum amount of moisture if luxuriant growth is to be expected.

## ANALYSES OF SOIL.

Paddy soils from Gannoruwa Village. Allagala District (Near Peradeniya.

**MECHANICAL COMPOSITION.**

| | *Rich Soil.* No. 1. | | *Poor Soil.* No. 2. | |
|---|---|---|---|---|
| Hygroscopic Moisture and Salts dissolved ... | 4·23 % | | 1·47 % | |
| Humus ... ... | 5·34 ,, | (2·66) | 1·93 ,, | (1·10) |
| Clay ... .. | 17·93 ,, | | 5·56 ,, | |
| Fine Silt ... ... | 31·02 ,, | | 10·14 ,, | |
| Silt ... ... | 14·16 ,, | | 8·31 ,, | |
| Fine Sand ... .. | 22·25 ,, | | 14·77 ,, | |
| Coarse Sand ... ... | 3·55 ,, | | 30·75 ,, | |
| Fine Gravel ... ... | 1·52 ,, | | 27·07 ,, | |
| Coarse Gravel above 3 M.M. ... | Nil | | 6·14 % | |
| Water Absorption... ... | 73·0 % | | 45·0 ,, | |

**CHEMICAL COMPOSITION.**

| | | |
|---|---|---|
| Moisture ... ... | 3·340 % | 2·460 % |
| Organic Matter and Combined Water ... ... | 14·720 ,, | 9·660 ,, |
| Oxide of Iron and Manganese ... | 13·760 ,, | 10·720 ,, |
| Oxide of Alumina .. | 17·554 ,, | 12·847 ,, |
| Lime ... ... | 0·180 ,, | 0·120 ,, |
| Sulphuric-an-Hydride ... | 0·096 ,, | 0·109 ,, |
| Magnesia ... ... | 0·230 ,, | 0·086 ,, |
| Potash ... ... | 0·378 ,, | 0·177 ,, |
| Soda ... ... | 0·509 ,, | 0·318 ,, |
| Phosphoric Acid ... ... | 0·141 ,, | 0·102 ,, |
| Chlorine ... ... | 0·012 ,, | 0·011 ,, |
| Silicates ... ... | 49·080 ,, | 63·390 ,, |
| Containing Nitrogen | 0·235 % | 0·168 % |
| Equal to Ammonia... ... | 0·286 ,, | 0·204 ,, |
| Lower Oxide of Iron ... | Trace | Fair |
| Reaction P.H. ... | 7·7 | 6·5 |
| Cetric Sal. Phos. Acid ... | 0·005 % | 0·006 % |
| Potash ... ... | 0·006 ,, | 0·007 ,, |

Although the results of the trials are not very satisfactory it would be advisable to continue the plots in most of the Districts, but only where they can be thoroughly supervised by the Agricultural Instructors under the Divisional Agricultural Officers.

Green manuring plots with some phosphatic manure such as Ephos Phosphate or bone meal should be the main feature. The other two manure plots might also be continued with slightly modified mixtures substituting Sulphate of Ammonia for the nitrolim and applying 1½ cwt. per acre in each case.

If possible the four acre plots should be divided into half acre plots so that each trial can be made in duplicate, half the manure being applied to each half acre plot.

Plot 1.—Green manure 2000 lb. and 112 lb. Ephos Phosphate costing about Rs. 7 per acre (in Colombo). The application of green manure would be about Rs. 5, making Rs. 12 in all.

| | | | | | |
|---|---|---|---|---|---|
| Plot 2.—General Mixture without Potash. | | | Containing | | |
| Fish Manure | ... | 63 lb. | Nitrogen | ... | 10·30 |
| Ephos Phosphate | ... | 75 ,, | Phos. Acid | ... | 25·65 |
| Sulph. Ammonia | ... | 30 ,, | Potash | | |
| | | 168 lb. | or 1½ cwt. per acre | | |

costing about Rs. 13·77 per acre (in Colombo.)

| | | | | | |
|---|---|---|---|---|---|
| Plot 3.—Groundnut Cake | ... | 56 | Nitrogen | ... | 9·4 lb. |
| Fish guano | ... | 56 | Phos. Acid | ... | 15·4 ,, |
| Std. Bone Meal | ... | 44 | Potash | ... | 6·3 ,, |
| Muriate of Potash | ... | 12 | | | |
| | | 168 lb. per acre | | | |

costing about Rs. 10·14 per acre (in Colombo).

Plot 4. Control.

In the case of the green manure plots the cultivators might be given the cost of cutting and application, about Rs. 5 per acre, where the method is new, as it is important to encourage this method of more permanently improving the soil condition for paddy.

The total cost per annum of each set of 4 acre plots including one acre Control or unmanured would be

| | | |
|---|---|---|
| 1. | Green manure and 1 cwt. Phosphate including Rs. 5 for cutting and application - - | Rs. 12·00 |
| 2. | General Mixture without Potash (A) - | ,, 13·77 |
| 3. | General Mixture with Potash (C) - | ,, 10·14 |
| | | Rs. 35·91 |

or allowing for freight and carthire about Rs. 40 per four acres.

Provision might be made for 40 such experimental areas which would cost Rs. 1,600, apart from the extra cost of travelling for Inspecting Officers.

As the benefits of manuring can only be brought before the cultivators by continuous demonstration, I suggest that in addition to the above Rs. 1,600 funds be provided in each province for a limited number of extra green manuring demonstrations as plot 1 costing say Rs. 12 per acre.

This sum to be given to the best cultivator in selected paddy areas of over 50 acres to carry out the experiment on one acre with the ordinary local cultivation methods, under the supervision of Agricultural Instructors. The cultivator to have the benefit of any increased crop provided he cultivates thoroughly, furnishes details of cost of labour and the crop obtained, and permits all interested to inspect the treated area.

With 10 such plots in each of the nine provinces, the total expenditure would be about Rs. 1,080.

A more comprehensive series of scientific experiments under the direct control of the Divisional Agricultural Officers in the main paddy growing districts is desirable, in order to ultimately arrive at the requirements of the rice plant as regards soil, amount of irrigation water and the methods of cultivation and manurial ingredients necessary to give the best results. This is in addition to actual experiments with selected varieties of paddy.

It is also important that standard measurements of areas and paddy should be adopted in each district, preferably based on the acre and bushel, so that comparisons may be more accurately made both of results obtained in the different Provinces of Ceylon and in other Paddy growing countries.

# SOME NOTES AND OBSERVATIONS ON SRAVASTI ESTATE (NACHCHADUWA SCHEME), ANURADHAPURA.

W. A. de SILVA.

I give below some notes and observations on the work done at Sravasti Estate, Anuradhapura, during the last twelve months.

2. One boundary of the land adjoins Ratmale, near the 4th mile on the Anuradhapura-Kurunegala road, where it touches the Northern Railway Line. The land extends eastward in a narrow strip, and borders the Yoda-ela to the west and south and Malwatu-oya on the east. The extent is about 1,000 acres irrigable under the Nachchaduwa Irrigation Scheme.

3. The land was covered with the average forest of the district, which may be over 800 years' growth, with large trees and an undergrowth of thorny stunted shrubs. The irrigable area is uniformly level, and the soil consists of the usual reddish loam, rather shallow, with a subsoil consisting of gravelly clay and sand, interspersed with narrow patches of soil containing a good deal of quartz gravel. These ridges, or veins as they can be termed, are far from fertile, and are indicated by the stunted growth of the forest trees growing on them.

4. I took over the land in June, 1920, and commenced the operations of clearing almost immediately. The forest was felled by employing Sinhalese labour, mostly on contract work, and wasd one by men who had experience in the felling of such forests for cultivation. Unless the felling is done in a proper manner, the subsequent clearing operations become very difficult, prolonged, and expensive, and theretore this first process required careful attention. All felling and lopping was stopped after the first week of August, and the felled jungle was fired in the third week of August. Clearing and re-firing was continued till the end of September.

5. Each district has its own methods in regard to the cultivation of land. It is very important that these should be carefully studied. The cultivation of rice is an industry that had been very highly developed and efficiently carried out in the North-Central Province in the early period of the history of the Island. The skill displayed in the work is evidenced from the tanks and irrigation channels which have been so well planned and laid out. It must naturally follow that a people who were able to bring their irrigation system to such perfection would also have developed their system of cultivation on the most economic lines, and their experience should always be made use of by those who attempt to reclaim such land.

In the North-Central Province el-wi, or high land paddy, does not find much favour. El-wi is successfully grown only in the hill districts, where there is an evenly distributed rainfall, and where the soil does not get too wet or too dry. The soil in el-wi fields is as a rule, dry soil, which is frequently watered by showers of rain. In the level tracts of the North-Central Province we have a heavy rainfall in the last two months of the year and the first month following. During the rest of the year the weather is quite warm, with very little rain. The dry land rice or el-wi has very little chance of success even were it sown, for the heavy rainfall keeps the flat land too wet and moist to suit the requirements of this variety of paddy, and in the dry months it is hopeless to attempt to grow el-wi, as it will have no chance of growing.

6. If one attempts to lay out an irrigable field immediately after the clearing of the forest, his attempt is bound to end in failure and heavy unnecessary expenses :—

(*a*) The land is so full of roots and stumps, the labour required in levelling up, rooting, and putting up ridges will be enormous.

(*b*) Weeds come up so fast in a newly-cleared forest, it is impossible to keep them down unless the land is immediately covered with a crop.

The most rational method is to sow rice immediately after the land is cleared by taking advantage of the showers of rain at the end of September or early in October. The varieties of paddy used should be the same as used in the wet fields in the district, and they should be timed to crop early in February. The best is to use four months' varieties, and if by some chance one is late, a three months' paddy can be sown, but the results of a three months' paddy will be most discouraging. The dry paddy is scattered and covered by using the mamoty, the rate for sowing being one bushel to one and a half bushels per acre. Where the variety is one that throws out a fair number of tillers, a bushel of paddy per acre should be the rule.

At Sravasti Estate I felled and cleared approximately 500 acres of land, and started sowing operations from the last week in September. Sowing operations were continued till about the middle of October, when over 400 acres were sown. A part of the remaining 100 acres was sown later than this, as I was not able to get the work completed in time. I used three varieties of four months' paddy : Dik-wi, Anakodan, Indrasal. Paddy was scarce at the time, and I had no opportunity for choice or selection. I obtained 20 bushels of Indrasal through the Ceylon Agricultural Society. Of these, 14 bushels were taken to Sravasti fields, and about 11 acres of land were sown with this variety. These germinated well and showed a very good growth, the plants tillering freely. It may be mentioned here that 6 bushels of Indrasal, which were sprouted and sown in mud fields at Kurunegala, did not germinate. The rest of the fields was sown with Dik-wi and Anakodan, both four months' paddies, and they showed a good growth.

The rainfall this year in this district was higher than the average, but the situation and the lay of the land was so good that there was hardly any collection of water or flooding of the fields, the water rapidly draining away. Reaping was started in February, and had to be continued for several weeks. The ideal should have been the taking in of the crop before the end of February. The delay in harvesting damaged the crop to a certain extent, but this had to be expected where large tracts have to be attended to in a district thinly populated, where one is not able to call in the help of neighbours to harvest the crops.

During the time the crop was growing, the only weeding that was done was the periodical removal of the new shoots which grew profusely from the stumps of trees left on the land. It is very important that this should be attended to carefully. The rapid removal of the young shoots assists in the ultimate decay of the stumps. They soon lose their vitality, and the process of dissolution starts rapidly. If the shoots are allowed undisturbed for any length of time, not only do the stumps re-start a jungle, but they retain their vitality, and the eventual work in reclaiming the land becomes a difficult task.

7. After the harvesting of the crop the appearance of the land became an interesting study. The big towering forest and the dense thorny shrubs were no longer to be seen. Most of the smaller stumps had disappeared entirely. The few months had been sufficient for the decay; wood cannot survive long the extreme heat and the alternate wet weather. The larger stumps remained, but the majority of them, without any vitality that will enable them to stand the inroads of another season's weather, changes. The thorny shrubs had lost their habitation, but a new generation of plants had rapidly started gaining ascendancy; these appear to be of more delicate habits, and if kept down till the dry weather sets in should have no chance of making their habitation on the reclaimed land. Therefore, it becomes necessary to take measures to sow a crop that will keep the new growth in check. A second crop of paddy cannot be sown immediately, for the land requires preparation to receive irrigation water as the long rainless period has to be faced. However, as soon as the crop was reaped, without any preparation, and on the stubble of the paddy crop, gingelly seed (*Sesamum*) was sown broad cast. The seed remained dormant till the few showers of rain came in April, when they commenced sprouting rapidly and choked out the new weeds. Those who sowed the gingelly seed lacked the ripe experience of the district, for the seed should be sown on the uneven unprepared ground with the stubble and stumps in such a manner so that they may drop fairly evenly. This requires much practical experience. An expert sower will be able to do his work in such a way as to get an even growth in the soil. Where this experience is lacking, it is as well to sow a larger quantity of seed than is actually needed. The gingelly is showing a moderately good crop. It will bring in some return, but its advantage is not so much the crop it produces, but the help it gives in checking the weeds during April and May showers.

The ridging of the land will be started in June, and should be completed in September. The next crop of paddy has to be sown about the end of September after using the mamoty to disturb the soil. The paddy will be sown dry, and as the plants come up irrigation water can be used. From the third year the usual method of mud cultivation can be followed, the fields can then be ploughed, puddled, levelled, sown, and irrigated, and two crops per year taken.

On the little patches of high land I experimented in the growth of annuals, such as Indian corn, kurakkan, pumpkins, sweet potatos, mustard, mung, herbs, and vegetables. All these came up successfully and produced good results, showing that such crops can be grown successfully. On some of the high land I have planted small patches of pine-apple, sugar-cane, and plantains. Pine-apple shows a good growth, sugar cane-and plantains have a fair growth, but is below the average in other districts.

8. In any pioneer agricultural work the problem of labour requires very careful study. The mere offer of increased wages is of little use, sometimes it leads to the collection of a force of men who are utterly unfit for agricultural work. The rate of payment should be much higher than in the developed districts; the work, however, should be given on contract or piece rates, and the employer should not grudge a man earning large sums through contract work, provided he gets his work done. For example, a Tamil

cooly's usual wages work out at about a maximum of 50 cents in developed districts. He is expected to do a certain quantity of work for this wage. In an undeveloped district the rate should at least be 50 per cent. extra. A wage of 75 cents per man will, however, do no good. It should be 75 cents for a similar quantity of work. The ordinary estate cooly, however, is not able to put in this quantity of work in a new district, he will work 50 per cent. less, and will be a failure. But to the man who is a skilled agricultural labourer, the 75 cents will be an attraction, for he is able to work and earn from a rupee to two rupees at his contract work. I have found from my experience that the ordinary estate labourer or the casual town labourer is utterly unfit to work in new districts. He is not skilled enough, and has not got the physique and endurance to stand work at a high pressure. The Sinhalese village agricultural labourer is often dubbed as a lazy man, who idles away his time in his village. When he has work to get through, he works hard and gets through it rapidly, and if the work cannot wait, he works night and day. When he is employed, he should be paid according to quantity, and usually he can put in twice to four times the work of a casual labourer. Cultivation work has to be given on a share system. The usual rate where the landlord supplies cattle, implements, and seed, the cultivator gets half share of the crop. If daily-paid casual labour or estate labour is employed, the cost of producing the crop becomes prohibitive, for casual labour requires careful supervision and does about a fourth of the work done by a cultivator in one day, and that, too, very unskilfully. I found it took four Tamil coolies and necessary supervision to finish—and that badly—the work of reaping or sowing that is done by a single villager.

9. All new districts are usually unhealthy, and a great deal of attention and care is necessary to conserve the health of men doing pioneer work. The men employed should be of a hardy physical constitution. They should be skilled in their work. They should be paid for the quantity of work done. They should receive advances for their food, mere issue of a quarter bushel of rice will demoralize such men. The work should be so arranged as to get most of it done during healthy months. June to September are very healthy months in the Anuradhapura District, and the average health of the men during this period is as good as that in the healthiest districts of the Island. During the rest of the year the number of labourers can be considerably reduced.

Sick people should not be neglected till they are unable to move. The slightest illness, even when the men are able to turn up for work, should be noticed, and such men should not be allowed to expose themselves to fatigue, and should receive immediate treatment. Convalescents also should receive similar attention, and should receive good food. A man with a slight attack of fever often goes unnoticed till he is weak and unable to move. When a man is sent to a hospital, he is discharged as soon as the symptoms of his disease disappear. He should receive treatment till he is strong and fit to work.

10. The financial side of rice cultivation should be looked for, not in the light of ordinary estate methods, but in that of a co-operative system of work. When the rice fields are ready for the plough, and the landlord has made provision for agricultural cattle, the labourers will take up the cultivation on a system of shares. A rice field in the district will give two crops,

and under ordinary cultivation, where the landlord keeps his part of the contract, that of supplying cattle, seed, and advances, the yield will work out at an average of 50 bushels per acre per crop, or 100 bushels per year. The employer's share will be 50 bushels of paddy per acre per year. An acre will yield a gross income of Rs. 75, calculating paddy at Re. 1·50 per bushel. From this sum Rs. 5 per acre will have to be spent for irrigation and rent charges when they are due, and Rs. 5 for supervision charges, and Rs. 10 for contingencies, leaving a nett income of Rs. 55. It should be possible to bring an acre of land under rice fields with an expenditure not exceeding Rs. 300. The income will work out at 18 per cent. on the capital.

11. The conclusions I have so far come to from the experience of the year's work are—

*(a)* That under a proper system of management the cultivation of rice can be made to pay.

*(b)* That there are vast tracts of unirrigable land in the district that can be made to yield one crop of rice a year regularly, and crops of annuals such as gingelly, maize, green gram, mustard, etc., during the rest of the year. Such land if properly attended to can be farmed, and labour-saving implements and modern methods of farming can be introduced.

*(c)* In rice cultivation the co-operative system of cultivation should be followed.

*(d)* With the opening of the land a resident population will be attracted.

*(e)* Along with rice cultivation on irrigable land, cultivation on unirrigable land should be undertaken as a supplementary work to give the cultivators opportunity of profitable work during such time when they are not engaged in the work of the rice crop.

*(f)* When land is opened, it should be kept under cultivation without allowing the hardy weeds to choke it.

*(g)* The soil is not suitable for the successful growth of perennial crops on a commercial scale.

# FOOD PRODUCTS COMMITTEE OF THE BOARD OF AGRICULTURE.

## FIRST MEETING—JUNE 20th, 1921.

*Minutes of the First Meeting of the Food Products Committee of the Board of Agriculture held at the Legislative Council Chamber, at 11-30 a.m. on the 20th June, 1921.*

*Present.*—The Hon'ble Mr. F. A. Stockdale, Director of Agriculture (Chairman), the Hon'ble Dr. H. M. Fernando, the Hon'ble Mr. O. C. Tillekeratne, the Hon'ble Mr. J. H. Meedeniya Adigar, the Divisional Agricultural Officer, S.D., the Divisional Agricultural Officer, C.D, the Divisional Agricultural Officer, N.D., the Economic Botanist, Mr. C. Drieberg, Mr. W. A. de Silva, Mr. P. B. Nugawela, R.M. and Diva Nilame, Gate Mudaliyar C. H A. Samarakkody, Gate Mudaliyar L. A. Dassanayake, Mr. A. Sabapathy, Mudaliyar G. A. Gunatillake, Mudaliyar V. M. Muttukumaru, Mudaliyar Edmund Peiris, Mr. C. W. Bibile, R.M., Messrs. E. C. Villiers, A. A. Wickramasinghe, C. C. Wilson, S. Muttutamby, S. Tiyagarajah, Mudaliyar J. H. Bahar and Mr. N. Wickremaratna (Secretary).

*Visitors.*—Mr. K. V. Markandan and Mr. Stephèn de Silva.

The CHAIRMAN commenced proceedings by welcoming the members of the Committee. He said that it was the first meeting of the Committee which consisted of representatives from all parts of the country and delegates from various Food Production Committees in the Island and its deliberations would be of considerable value to the country and that it would assist the Government and the Department of Agriculture in fostering the greater production of food.

The CHAIRMAN announced that MR. A. W. BEVEN had resigned from the Committee in favour of GATE MUDALIYAR A. E. RAJAPAKSE, but as MR. BEVEN was nominated by the Ceylon Agricultural Society the matter would be put before the next meeting of the Society.

**Agenda Item 1.**

THE CHAIRMAN next gave details of paddy manurial experiments carried out by the Department during the last year in 45 plots in different parts of the country to find out the relative value of the following fertilizers, viz. :—

(1) Green Manure and Phosphate
(2) Complete Mixture
(3) Sterilized animal and Bone meal

The Divisional Agricultural Officers of S.D. and C.D. gave results of experiments in the respective divisions.

The CHAIRMAN pointed out the good results from the use of green manures and phosphates and said that the complete details would be published in the TROPICAL AGRICULTURIST.

A discussion followed in which Messrs. C. C. Wilson, E. C. Villiers, W. A. de Silva, C. Drieberg, Dr. H. M. Fernando, Messrs. N. Marshall and Nugawela took part.

MR. WILSON enquired whether lime had been tried and what were the effects of Nitrolim. The CHAIRMAN explained that the use of Nitrolim in paddy fields was in the experimental stage and that it had to be used with caution.

MR. VILLIERS enquired regarding the use of refuse dried fish as manures, The CHAIRMAN said that it was not much used in Ceylon, but fish guano was becoming popular in Madras.

The Divisional Agricultural Officer, N.D., gave an account of the use of fish manure and the results of green manuring practised in Madras.

MR. DRIEBERG said that green manure was used in the North.

MR. NUGAWELA said that fish manure and sweepings from the boutiques were used in the Kandy district and the results were satisfactory.

DR. FERNANDO suggested the carrying out of twin experiments side by side with (1) phosphates as bone dust and (2) phosphates in other forms to find out their relative value.

MR. DE SILVA enquired whether the soil has been examined before trials as otherwise its results would be of little value and suggested that the soil of experimental plots should be examined physically and chemically and that the analyses should be published.

The CHAIRMAN explained the present practice and promised to discuss the matter with the Government Agricultural Chemist regarding analyses. It was decided to continue the experiments and to popularise in all districts the use of green manures.

**Agenda Item 2.**

This was postponed to a subsequent meeting at the request of MR. P. B. NUGAWELA, R.M.

**Agenda Item 3.**

MR. W. A. DE SILVA read his paper entitled "Some Notes and Observations on Sravasti Estate (Nachchaduwa Scheme) Anuradhapura" giving the following conclusions from the experience gained during the first year of the work :—

(*a*) That under a proper system of management the cultivation of rice can be made to pay.

(*b*) That there are vast tracts of unirrigable land in the district that can be made to yield one crop of rice a year regularly, and crops of annuals, such as gingelly, maize, green gram, mustard, etc., during the rest of the year. Such land if properly attended to can be farmed, and labour-saving implements and modern methods of farming can be introduced.

(*c*) In rice cultivation the co-operative system of cultivation should be followed.

(*d*) With the opening of the land a resident population will be attracted.

(*e*) Along with rice cultivation on irrigable land, cultivation on unirrigable land should be undertaken as a supplementary work to give the cultivators opportunity of profitable work during such times when they are not engaged in the work of the rice crop.

(*f*) When land is opened, it should be kept under cultivation without allowing the hardy weeds to choke it.

(*g*) The soil is not suitable for the successful growth of perennial crops on a commercial scale.

He further said that he did not touch on the difficulties such as labour, sickness, etc., which have to be overcome.

MR. DRIEBERG congratulated MR. DE SILVA on the success of his enterprise and remarked that he thought the average yield was estimated a little too high.

MR. DE SILVA said that he had gone over the question carefully and the average there for years was between 40 and 50 bushels per acre per crop.

DR. FERNANDO made lengthy remarks based on personal observations gathered during his visit to the estate. He mentioned two points which required attention. He said that care should be taken not only to prevent infection of malaria from mosquitos but also the prevention of human beings —those suffering from malaria— from infecting the mosquitos. He was glad to observe that the Principal Civil Medical Officer had taken prompt action in the appointment of a Malariologist. He suggested that considerable quantities of foodstuffs could be grown on non-irrigable lands and that labour-saving machines could be utilized.

MR. VILLIERS wished to know whether MR. DE SILVA had any figures in connection with other crops such as gingelly and currystuffs. MR. DE SILVA said that a bushel of gingelly could be sold at Rs. 5 to Rs. 7 and that he had no calculation made on the rest but that gingelly and other crops were cultivated as subsidiary crops to give work for the labourers during intervals.

MUDALIYAR MUTTUKUMARU asked whether any damages were done by insect pests and MR. DE SILVA said that he allowed a certain portion for the paddy fly and other insects and animals.

MR. TYAGARAJAH thought that there was risk in experimenting with unirrigable land.

MR. MEEDENIYA enquired about the growth of Indrasal paddy. MR. DE SILVA said that it took time to sprout. The CHAIRMAN explained that the Department of Agriculture had some experience with Indrasal at Peradeniya and Anuradhapura Experiment Stations. It did much better at Anuradhapura than at Peradeniya.

MR. SABAPATHY enquired whether the outturn of the whole 500 acres was available and MR. DE SILVA replied that the thrashing was not complete, but expected to get a yield of 7,500 bushels. He had spent Rs. 80,000.

The CHAIRMAN said the average outturn at the Government colony at Nachchaduwa was 26½ bushels per acre in the first crop, and in certain areas it was 33¼ bushels. He explained the present method of cultivation of chenas and said that he was in favour of undertaking an experiment on unirrigable lands. He thanked MR. DE SILVA for his interesting paper.

A discussion ensued as regards the cost of clearing of an acre. MR. DE SILVA's expenditure was Rs. 35 to Rs. 45 per acre. MR. MEEDENIYA said it cost him Rs. 25 at Ratnapura where he had cultivated last season 200 acres with kurakkan and 80 acres of paddy. MR. WILSON said that it cost only Rs. 15 to Rs. 18 twenty years ago. MUDALIYAR MUTTUKUMARU said that at Karachchi Scheme it cost him only Rs. 25 to Rs. 30 per acre.

**Agenda Item 4.**

MR. C. DRIEBERG moved the following motion: The desirability of calling for reports and returns of the various paddy schemes initiated by the late Food Production Department."

DR. H. M. FERNANDO seconded and the resolution was carried.

MR. VILLIERS and the CHAIRMAN offered remarks.

**Agenda Item 5.**

THE HON'BLE DR. H. M. FERNANDO moved the following motion:— "In view of the fact that Government has abandoned the policy of increasing food production in this country by means of legislation to consider whether it is desirable that in the alienation of Crown Lands for agricultural purposes in the future provision should be made, that a definite proportion of each land so alienated be devoted entirely to the growing of Food Products."

MR. MEEDENIYA thought that such provision would interfere with the villager and his chena cultivation.

GATE MUDALIYAR DASSANAYAKE wished to know what percentage of the acreage was to be reserved for food production and for how many years.

MR. NUGAWELA supported the motion and said that it referred to estates and not village people owning small areas.

MUDALIYAR GUNATILLAKE said that he was under the impression that the legislation for compulsory cultivation was given up owing to the feeling in the country.

DR. FERNANDO replied that his motion referred to estates of 30 acres and more.

MR. A. SABAPATHY enquired whether the question referred to the land alienated in the future.

MR. DE SILVA supported the motion and suggested the appointment of a sub-committee to go into the question.

The CHAIRMAN suggested in view of the possible far-reaching effect of the motion that it should be brought before the Estate Products Committee at their next meeting in July and after being discussed by that body to bring it before the full Board of Agriculture in the form of a resolution at the next meeting in August when HIS EXCELLENCY THE GOVERNOR is expected to preside.

This was agreed to.

**Agenda Item 6.**

MR. C. C. WILSON moved "That the Government be asked to bring in an Agricultural Act similar to the act passed lately in the United Kingdom, the principle of the suggested act being to require the proper cultivation of all grain crops."

The CHAIRMAN explained the provision of the English act.

MR. W. A. DE SILVA strongly objected to the motion.

A discussion followed in which Messrs. Nugawela, Wickremasinha, Samarakkody and the Chairman took part.

The CHAIRMAN undertook to enquire into the existing Village Committee and Irrigation Rules and to report to the Committee whether cultivation rules could be brought in under the Irrigation rules. This was agreed to.

**Agenda Item 7.**

MR. DRIEBERG moved the first part of the motion viz. "To consider the success, if any, attending the attempt to introduce a rotation of crops in Chenas."

MR. WILSON moved the advisability of advising Government that in future chena lands should only be leased on the understanding that they are cultivated on rotation system.

The CHAIRMAN explained that experiments had been made with regard to rotation of crops in chenas but that he was not prepared to say anything definitely about results obtained at present. It was necessary to continue experiments for a number of years before a definite decision could be come to. It was agreed to await the results of the experiments in rotation of crops now carried on by the Department before steps were taken in the matter.

**Agenda Item 8.**

MUDALIYAR G. GUNATILLEKE moved the following resolution passed at a meeting of the Galle Food Production Committee: To consider a resolution from the Galle Food Production Committee:—to ask the Director of Agriculture to include a sum of Rs. 500 in his estimates for 1921-22 for destruction of monkeys in Galle District so that a commencement may be made in Talpe Pattu," and in support of the motion he read the reports of the Chief Headmen of the Galle District testifying to the damage done by monkeys to food crops.

Messrs. Meedeniya, Samarakkody, W. A. de Silva and Nugawela spoke against the motion. Mr. Edmund Peiris thought that village committee funds were available for the purpose.

MUDALIYAR GOONETILLEKE replied and MR. AUCHINLECK supported the motion.

The CHAIRMAN asked the Committee to consider the subject in detail. These were the opinions of the Chief Headmen of the Galle District, and the Buddhists. He left the motion to the Committee.

The motion was put to the house and lost.

**AGRICULTURAL INSTRUCTORS FOR UVA.**

MR. C. W. BIBILE, R.M. moved that three more Agricultural Instructors be appointed to the Province and also two Cultivation Officers for the major works at Umaoya, Kumbukkan oya and Badulla.

The CHAIRMAN said that he had correspondence on this subject with the Government Agent, Uva Province, and that if the Legislative Council sanctioned sufficient funds he would make every endeavour to get two or three Instructors for the Province of Uva.

The meeting terminated with a vote of thanks to the Chair.

N. WICKREMARATNE,
Secretary, Food Products Committee.

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# MINUTES OF MEETINGS OF FOOD PRODUCTION COMMITTEES.

## KANDY.

*Minutes of a Meeting of the Kandy Food Production Committee held at the Kandy Kachcheri on Friday the 6th May 1921, at 2 p.m.*

*Present.*—Hon'ble Mr. W. L. Kindersley (Chairman), Messrs. G. Harbord, A. B. Talgodapitiya, W. Molegode and R. S. Pelpola.

(1) Read and confirmed minutes of the previous meeting held on Friday the 4th February, 1921.

(2) Letter No. 2,338 of 15th April, 1921, from the Director of Agriculture was read. Resolved that the Divisional Agricultural Officer be made ex-officio member of the Kandy Food Production Committee.

(3) Letter No. 208 of 31st March, 1921 regarding Grants-in-aid for Agricultural Shows and Competitions received from the Director of Agriculture was read. Resolved to raise the amount of prizes for paddy cultivation in Udu Nuwera to Rs. 160 and to refund the balance after allowing for printing.

(4) Statement of Lands leased for cultivation of foodstuffs was tabled.

(5) Diaries and programmes of work of the Agricultural Instructors were tabled. Resolved that in future the diaries be sent to the Divisional Agricultural Officer instead of the Government Agent.

(6) MR. HARBORD proposed to get 4 plots of about one pela each in each Ratemahatmaya's division and to manure these as object lessons. Resolved that it is desirable that these experiments be undertaken. The Government Agent undertook to write to the Ratemahatmayas to secure plots.

## MATALE.

*Minutes of the meeting of the Matale Food Production Committee held on 22nd April, 1921, at the Matale Kachcheri at 2 p.m.*

The Assistant Government Agent presided and there were present Messrs. R. Senior White, G. Harbord, H. Storey, Ratemahatmayas of Matale South and North, four Agricultural Instructors and the Secretary.

Minutes of the previous meeting were read and confirmed.

*Experimental paddy plots.*—Read reports of the Agricultural Instructor which were discouraging. Resolved that the same plots at Totagomuwa

and Weragama be sown for Yala without any manure and the Agricultural Instructor be asked to make a full report regarding them. It was also resolved that any demonstration plots for next Maha must be carefully prepared well in advance and that they be in charge of the officers of the Agricultural Department whom the Committee and the Ratemahatmayas will assist in selecting plots, etc. Divisional Agricultural Officer be asked to inform the Committee what his requirements are after which the Committee will endeavour to do what is required.

*Raitalawa and Nikawella anicuts.*—Resolved that the Director of Irrigation be asked to take up the question of constructing these anicuts.

*Potato Cultivation.*—After some discussion on the subject it was decided to drop the matter as potatos do not thrive in the district.

*Rewards to Irrigation Headmen.*—Resolved to give Mutu Banda, Velmuladeniya, of Pamunuwa in Matale South a reward for specially good work done with regard to the cultivation of the paddy fields in his area. Ratemahatmayas of Matale North and East be asked to submit recommendations with regard to Velmuladeniyas' work in their divisions in consultation with the Agricultural Instructor.

*Experimental Gardens.—Saxton Park and Maningomuwa.*—Resolved that the reports of the Agricultural Instructors be circulated among the Committee Members for their comments.

*Membership.*—Resolved that MR. C. P. ANDERSON (in place of MR. HENRY) and MR. H. D. GARRICK be elected members of the Committee. MR. H. STOREY who was appointed in place of MR. GARRICK retains his membership. The Divisional Agricultural Officer, Central Division, is ex-officio a member of the Committee.

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## MATARA.

*Proceedings of a meeting of the Food Production Committee held at the Kachcheri on the 15th June, 1921, at 3 p.m.*

*Present.*—Mr. J. D. Brown in the chair and the following gentlemen: Messrs. G. Auchinleck, C. Zanetti, D. M. Rajapakse, G Altendorff, M. Joonoos, M. J. A. Karunanayake, J. Wijesinhe, Dr. V. D. Gooneratne, Mudaliyars W. A. Ameresekere, W. A. Perera, P. F. de Livera, D. L. Weeresinhe and F. Wickremaratne.

1. Read and confirmed the minutes of the meeting held on 17th January, 1921.

2. Resolved that a series of lectures on topics of Agricultural interest be organised by the Agricultural Department to be delivered under the auspices of the Food Production Committee.

3. Resolved that MR. AUCHINLECK, Divisional Agricultural Officer, S.D. be asked to deliver a lecture on improvements to coconut cultivation in October next at the District Court Hall.

4. That the draft rules for Vegetable Garden Competition submitted by the Divisional Agricultural Officer be approved with the following amendment under (a) "Entries" and (b) "Judging."

(a) The villagers who intend to compete should give their names and details, etc., to the Mudaliyar of the District who will send out the particulars immediately in accordance with arrangements made between the Assistant Government Agent and Divisional Agricultural Officer.

(b) At the preliminary judging the Vidana Arachchi of the division should be associated with the Agricultural Instructor or other officer appointed for the purpose.

5. Tabled correspondence with MR. GOONETILKKA concerning the plot of land lent to Government by him.

Proceedings terminated with a vote of thanks to the chair.

# COFFEE.

## LIBERIAN COFFEE.

### ITS CULTIVATION AND PREPARATION FOR THE MARKET.

**W. H. MATTHEWS,**

*Resident Agricultural Instructor, Pomeroon District, British Guiana*

The planting of Liberian Coffee is fairly widely performed throughout the Colony, but unfortunately sufficient attention is not given to its cultivation; hence the crops obtained are for the most part mediocre. For the purpose of helping growers to get the best possible yields the present article is written. In it are indicated the lines along which the plants should be cultivated for best results, and as at present prices for the finished product are low, increased output is necessary to offset low prices. By strict adherence to the principles enunciated, maximum yields will result.

*Soil.*—A clay soil not too stiff in texture and containing a fair percentage of vegetable matter is best for the cultivation of Liberian Coffee—while a pegassey soil grows this species of Coffee well, and indeed during the early growth of the plant it far surpasses that made by plants in soils of a clayey nature, it is, however doubtful, whether yield will be maintained so well in a pegassey soil as is the case with more fertile clay soils.

*Drainage.*—The provision of proper drainage for Liberian Coffee is a matter of first consideration—where the land is insufficiently drained the leaves of the plants show it by their pale yellow colour, regaining their dark green healthy colour only after the drainage has received attention.

*Selection of Seed.*—Next in importance to proper drainage comes seed selection, as upon selection depends future yields, while it is possible in the case of short growing crops to correct errors due to bad selection or rather non-selection of seed, this is not possible in the case of coffee and other permanent crops which keep on growing for years after having once been planted. Therefore it is a case with these crops of selecting "now or never."

In the case of farms or estates that are being started in districts where Liberian Coffee is not grown, perhaps the most convenient way to get plants would be to purchase plants in baskets—but in the case of established farms, where the farmer is desirous of extending the cultivation, selection of berries from his best bearing trees is recommended. As, however, selection embraces many points, it had better be given in detail below :—

(1) Ascertain during crop time the plants which give the best yields, noting (a) habit of plant as to vigour and growth (b) proportion of skin to bean in the berry.

(2) See that the plants chosen as seed-producers conform to one particular type—Liberian Coffee plants exhibit great divergence of types, hence this restriction—choosing only one type of plant tends to uniformity of the offsprings and makes maximum yields a certainty.

(3) Having paid due regard to the above points in selection, gather from the plants chosen only berries that are fully ripe, (the colour of a fully ripe berry is a deep red) and the largest ones. It is also advisable to have the berries all of one size or as nearly so as possible.

*Sowing.*—After completing the selection of the berries, the berries can either be sown straightaway, that is, as they are in berry form ; or they may be first pulped to separate the skin from the seeds, the mucilage being washed off the seeds with water, and the seeds air dried and then sown.

The correct way to sow coffee seeds is in small beds, say, 3 feet to 4 feet wide, prepared across a large 3 rod bed, paths of 18 inches being left between each for walking. These small beds should be sufficiently loose in texture and well drained. If not sufficiently loose by nature they may be made so by the incorporation of vegetable matter. Such a nursery should be made in a central place in order to facilitate the transportation of the plants to their permanent places at planting time.

As too much transplanting tends to check the growth of seedlings it is advisable in sowing the coffee seeds to set them rather far, say, 9 inches apart each way, that is, 9 inches between the rows and 9 inches between the seeds. To allow for possible failures two seeds may be set at each 9 inches space, removing one, of course, should both seeds germinate and grow. Plants growing from seeds set thus far make more robust growth and consequently do better after they have been permanently put out in their places in the field than do plants that have been set rather closely in the Nursery beds and as a consequence make leggy growth. The reason why the former make more desirable plants is the fact that widely spaced seedlings grow leaves from very near the ground and as a consequence branch low down while the leggy plants begin branching higher up the stem. It will thus be seen that in a given distance from the ground the former will have more branches to the plants than the latter and consequently yield more.

Germination of coffee seeds takes place in 6 weeks. After sowing watering should be done and weeds removed, and so regularly on until the seedlings are ready to be permanently planted out, shade should of course be provided for sheltering the seedlings during the heat of the day. In connection with watering only sufficient to keep the soil moist is necessary, as over watering is more harmful than beneficial, giving rise to dampness.

*Preparation of the land for planting.*—Before the plantlets are ready to be planted out it is requisite that the land be laid out in beds 3 rods wide by digging 2 ft. by 2 ft. drains at every 3 rods, the earth thrown out of the drains in digging being thrown along the centre of the beds and so raising the middles. After the beds have been formed, lining should be done so as to mark the places in the beds where the plants are to be permanently planted. The beds being 3 rods wide leave out from each drain 6 feet distance and run rows on either side of the bed parallel to the drains and 6 feet distance from each, you will have then 2 lines or rows 24 feet apart. As it is, however, necessary to have your rows only 12 feet apart a middle row can be put in midway between the two outer rows, thus allowing 3 rows to the bed, each row being 12 feet apart, and the outer rows 6 feet from the nearest drain. The rows having been correctly spaced and run, mark off in the rows the places where the plants are to be set, leaving a distance of 6 feet clear from the edge of the bed. The first plant in each row being 6 feet from the "bed head" peg off from this every 10 feet along the row until the other end of the bed is reached and then similarly deal with the other beds, row by row. The planting distance for each plant will therefore be 12 feet

by 10 feet, meaning 12 feet between the rows and 10 feet between each plant in the rows. Undoubtedly planting in rows takes time but the ultimate gain more than compensates for the little trouble taken. By planting in rows each plant is given its own space, its own share of light, air and soil, and consequently uniform growth is made by the plants, resulting in a uniform yield.

After lining is complete, unless the soil is very loose in texture, holes should be prepared for receiving the plants. By preparing holes is meant the excavation of the earth around each peg and the peg being the centre of the hole. The size of the holes should be 24 to 30 inches wide and 12 inches deep. The soil removed from the holes should then be well chipped and mixed with vegetable matter before returning it to the hole, raising the middle so that the finished hole is mound-shaped. Some people look on the recommendation of holing as being "high-falutin" but surely a little extra attention given to a plant that is to continue in one place, not for months. but years, is desirable. In the life of such plants the extra cost of making them comfortable and giving them a good start is more than counterbalanced by subsequent yields.

*Planting.*—This is to be preferably done during showery weather when sun and rain alternate. Afternoon planting is best, that is, any time after 3 p.m. The plants are carefully lifted from the beds, small openings on top of the mounds in the field made and the plants planted, pressing well down around the roots with the hands or feet as the plants are put down, after which draw up a little loose soil above the roots and about the stem but not too high up. This drawing up the soil around the stem and over the roots will check evaporation from the soil below and confine the moisture in the vicinity of the roots where it is most needed. As a guide how deep the plants should be planted, note the mark on the stem showing depth at which they stood in the nursery beds and put them down at this depth.

Plantlets 6 to 8 inches are best for planting out in the field: although some people prefer to plant when smaller, and others when larger. Watering after planting is advisable in order to settle the soil well about the plant roots. The cooling effects of water on the roots also help plants planted in the afternoon to pick up during the cool of the night and so be in a better position to withstand the heat of the sun, should the next day after planting be a very hot one.

*After-cultivation.*—After cultivation embraces weeding, pruning, forking about the roots during the early stages of growth, topping and gathering the ripe berries annually after fruiting begins.

*Weeding.*—Liberian Coffee is a plant that must be kept quite free from weeds—clean weeded, that is, where grass and weeds are allowed to grow unrestrained the leaves of the coffee plants become very pale tending towards yellow. Further, if the grass is of the high growing kind it will be found that the lower bearing branches of the plant gradually die, while suckers arise from low down the stem giving the plant altogether quite an uncultivated look. Proper and regular attention to weeding enables the plant to make uniform growth and to maintain its healthy appearance, as is evidenced in well kept farms. As a means of keeping down the growth of weeds and at the same time getting the means of likelihood during the waiting years between the planting and gathering in the first crop, catch- cropping with ground provisions is usually done. It should not be forgotten, however, that such provision crops as are grown between Coffee are secondary to the Coffee, hence any encroachment on the Coffee plants should be prevented by sacrificing the provisions for the Coffee and not, as is often the case, the Coffee for the ground provisions. Each year as the Coffee grows and spreads the ground provisions should be planted farther and farther away, thus enabling the coffee to do its best and arrive earlier at maturity.

*Pruning.*—The Liberian Coffee is such a very good bearer that it will give fair returns for the minimum amount of pruning done. This fact is so well recognised by farmers, generally, that they rather under-prune than over-prune. Yet it has been the writer's experience that pruning done early and regularly has a decidedly invigorating effect on the future yields of plants. Pruning to be effective must be begun as abovesaid early in the plants' life, and in the nursery beds, should suckers arise on the main stem of young plants. Many farmers regard the many-stemmed plant as a better bearer than a plant having only one main stem. A consideration of the two kinds of plants soon shows the fallacy of so thinking. For while a plant having one main stem gives off its branches in regular order around the stem, the many-stemmed plants do so on their outer sides only, thus in the end being worse off, as while the two kinds of plants may have the same area of bearing branches at first and perhaps a slight difference in yield, in course of time the many stemmed plant soon runs down in vigour and naturally in yield while the one stemmed plant increases both its crops and vigour with the years.

Besides removing suckers by pruning them off from the main stem, pruning also embraces the thinning out of the secondary and tertiary branches. Secondary branches are those growing out from the branches, while the tertiary ones are those growing from the secondary branches. If no thinning is done the plant becomes a tangled mass of branches which results in poor yields. By thinning out the branches light and air are allowed to circulate better in and about the plant thus inducing fruitfulness. An important rule to observe is to have the middle of your plant open by removing branches growing towards the middle or too near the middle of the plant. The main stem—all branches should grow outward and away from the main stem. Begin early in the plant's life to check undesirable growth and so direct growth in the proper directions. Neglecting to remove branches and shoots early only makes the work of pruning harder in the future with no benefit to the plant. Observant farmers must have noticed that where a fairly large shoot has been removed there springs up from around the mound made many more shoots which also require to be removed. Removal of shoots when just peeping out saves this extra work and benefits the plant by diverting sap into the branches which you want to grow and fruit

Pruning further includes removal of dead wood or dried portions of branches, while sometimes the removal of some leaves is necessary.

While it is necessary to remove suckers or shoots growing from low down the stems of healthy and vigorous-growing plants (which suckers grow in an upward direction) there are nevertheless times when a sucker serves a useful purpose, such as rejuvenating an old plant or as sometimes is necessary, a young plant that has been suffering from neglect. In such cases a sucker growing from as near to the ground as possible on the stem, is selected and trained up as a new stem and subsequent suckers arising being pruned off. In course of time such a sucker grows and branches becoming a new plant. Old Coffee plants which have run to wood and are declining in yield could be treated as above mentioned. Quicker returns are obtained by so treating worn-out plants than if seedlings were planted to form a new cultivation.

*Topping.*—By topping is meant the stopping of the upward growth of the central or main stem of the Coffee plant by pinching off the terminal bud at top in order to concentrate its energy into the already developed branches. Topping to be effective must be done as soon as the required height has been reached. To allow a plant to grow 20 feet high and then to cut it back to 12 feet is not a desirable way of topping as the suckers arising at the top of the plant consume much labour in checking their growth. When, however, topping is done at the height desired the terminal bud is

easily removed as its growth is then soft and the head of suckers that spring up as a consequence is more easily removed. Better still, dis-budding is possible in the latter case. By dis-budding is meant the cutting out of the buds for 4 or 5 whorls below the terminal bud at the same time as topping. These buds are to be found just below the branches or whorls of branches and should be removed with some of the wood, deep enough to get out the buds entirely. When topping is done it is the buds nearest the top of the plant that shoot up, as it were, to replace the terminal bud removed, by continuing the upward growth. Therefore to make the topping effective and save time you disbud these buds and prevent their growth once for all.

As regards height at which to top there is no laid-down rule. Some people top at 4 feet while others do not top at all. As, however, observation of plants allowed to grow unrestrained shows that the plant becomes soon exhausted, topping is advisable to save the plant from itself, as it were. The writer considers a minimum height of 6 feet, and a maximum of 12 feet, about the best where high or low topping is desired. While topping increases fruitfulness it must also be remembered that the crop of a coffee plant depends on the number of bearing branches therefore the greater the number of bearing branches to a plant the greater the crop. Some people, however, prefer low plants of 6 feet height in preference to trees of 12 feet height as saving the use of cumbersome ladders. Topping at 12 feet will however, give maximum crops without seriously affecting the vigour of the plants.

*Crops.*—Liberian coffee arrives at its full bearing stage in from 5 to 6 years. This does not mean that no berries are borne until 5 years but rather that a full crop of berries is not borne until the tree reaches 5 years at the earliest. A few flowers, and therefore berries, will be borne sometimes as early as 2 to 3 years but not until 7 years will the tree give its best yield. An average yield of from 8 to 10 lb. is given by one plant at 7 years of age. Individual plants, however, sometimes give yields far in excess of this but this is rather the exception than the rule. And here is where the value of selection comes in. For while on a farm will be usually found many plants giving poor yields, a few plants giving average yields, and fewer still giving high yields due to non-attention to selection, a cultivation consisting of properly selected plants will give uniformly high yields ; hence the advantage of selection over non-selection of plants or seed.

In gathering the crop ( which starts about the latter part of November or in December, according to weather conditions, and continues on to February or March of the next year ) only the properly ripe berries should be picked. A ripe berry is of a deep red colour. The berry alone should be removed in picking, leaving the stem on the plant, or rather, the branch. This is important as if the stem is removed it reduces the next crop as is the case with Cacao. This accounts for the reason why when ripe berries are left on the tree to dry the next year's crop is much reduced. It therefore pays to pick ripe berries from a plant, instead of leaving them to dry on the tree, as the producing powers of the plant is thus maintained. Farmers who do not pick off the ripe berries from their plants, because, they say, it does not pay at present prices, are injuring their plants and will find, should prices rise, that they have made a fatal error in not so doing.

*Pulping.*—Coffee berries should be put through a pulping machine as soon after picking as possible as delay in so doing makes pulping difficult. Fresh berries pulp more easily than when left over for some days. The pulping makes possible the separation of the skins from the beans by crushing the berries without injuring the beans and their parchment covering.

*Fermentation and Washing.*—After the beans come out of the pulper they must be put up into heaps so as to allow fermentation to take place and so cause the mucilage on them to be readily removed by washing. The time

allowed for fermentation is 3 days, and during this period the heaps should be regularly turned so as to equalize fermentation throughout the heaps. At the end of 3 days the fermented coffee beans are put into large boxes and subjected to running water so as to remove the mucilage on the parchment covering of the beans. For small lots of fermented beans a tub can be used by half filling it with water and putting in enough beans to allow of complete washing off of the mucilage. A hole in the bottom with a plug to stop water from running out is necessary. Should the first water not completely remove the mucilage fresh water can be added after allowing the first water to drain through the hole in the bottom of the tub by removing the plug. Rubbing between the hands hastens removal of the mucilage in washing.

*Drying.*—After the mucilage has been removed, by washing the beans in their parchment covers are then put out, after first draining the water from them, to dry. Wooden platforms, having movable shelters over them are used for the purpose, sometimes the platforms are movable and the shelters permanent. In any case the object of drying is the same. It is necessary in spreading out the washed beans to dry, that they be thinly spread as a more uniform drying takes place. Frequent turning during drying should be done. With the maximum number of hours of sunshine per day drying takes from 6 to 7 days, but longer, should the days be intermixed with cloudy days. To arrive at a correct idea as to whether drying is complete, the method employed is to test a few beans, after removing the parchment covers, by pressing on the bean with the thumbnail. If the nail cuts into the bean further drying is necessary ; but if the thumb nail does not cut into the bean when pressed, drying is complete.

*Hulling.*—After drying has been completed there remains the last process of hulling, to separate the parchment covers or hulls from the beans. This is done by a hulling machine on large estates, or by pounding in a mortar on very small estates. As the hulls go one way and the beans another, the beans can at once be bagged off as they drop from the hulling machine, thus packing or bagging while hulling is in process for shipment.

*A New Method of Treating Coffee Berries.*—The above process is the recognized way of preparing Coffee for the market but some years ago a new method was tried in Pomeroon and proved so successful as to be now the fashionable method. It differs from the recognized method in that washing is eliminated. The pulped Coffee after being fermented is spread out on the drying platforms straightaway. Drying, however, in this case, takes 3 days more, as the mucilage is not washed off. When drying is complete, hulling is done as before and the hulled product put into bags for shipment. It may be mentioned incidentally that a standard bag of Coffee contains 200 lb. of cured beans. An advantage to the farmer of the latter process is that the cured product is heavier in weight than when prepared according to the former method. The Coffee drinker has also the advantage of an improved aroma, approximating that obtained from berries allowed to ripen and dry on the trees. No doubt the mucilage which probably is absorbed by the beans in drying is accountable for the improved aroma.

*Pests.*—Fortunately there are a few pests but no disease that trouble Liberian Coffee plants in this Colony :—(1) Scale insects are sometimes found on the plants but only in a mild form. (2) Bird-vines are, however, exceedingly troublesome, if left unrestrained, and kill the plants when so left. The farmer who, however, prides himself as a farmer will see to it that bird-vines do not get a foothold on his plants by removing them as soon as seen. (3) Black ants are sometimes a nuisance to pickers but they are only present to an appreciable extent where weeding and keeping the plants free from vines and other undergrowth have been neglected, as also where pruning is conspicuous by its absence.—JOURN. BOARD OF AGRIC., BRITISH GUIANA, Vol. XIV, No. 2.

# FOODSTUFFS.

## ADLAY—A NEW GRAIN.

P. J. WESTER,

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One by one the various economic plants throughout the tropics are becoming the object of study and experimentation with a view to their utilization in one way or another. Now it is a new, undescribed species fresh from the jungle, again, it is a plant once important in a now half forgotten (shall we say) civilization that still is grown in a desultory fashion somewhere in the by-ways of the world. One of the more interesting plants in the latter class, which hitherto has escaped notice is the Adlay, *Coix lacryma-jobi* L. The name Adlay, which has been adopted for common usage is Visayo. Other names of adlay in this dialect are Lamudias and Palias; names in Tagalo are Bintikay, Koldasan, and Tigbi; in Ilocano, Abukay and Atakay; in Bicolana, Aglay, Alimidias, Barubayoko, Katigbi, Panas, Damao, Pintaka, Puyas, and Tigbikau; in Ibanag, Agagay; in Pangasinan, Balantakan; in the Mountain Province, Agda, Aggay, Apagi, Apgaki. The soft hulled variety is by the Ilocanos known by the name Ilas, as distinguished from the wild plant bearing hard, bead-like seeds.

The adlay is a coarse, annual grass, from 1 to 2·5 meters tall, probably a native of India and adjacent countries. The seeds of grains of the common wild form, are hard, bead-like, and shining, and because of them the plant is cultivated as an ornamental in America and Europe. In the Philippines it grows wild and the seeds are used for making necklaces and portieres and for ornamental pictures, frames, etc. An interesting plant in itself it is of but little economic value. On the other hand there is another variety of adlay with soft hulls, easily removed from the kernel. This is grown as a grain in a more or less haphazard fashion in the Asiatic tropics, in China and Japan, including the Philippines.

In one sense adlay is new for it was probably cultivated as a grain perhaps three to four thousand years ago, but it is new in the sense that not until now has its cultivation been proposed on a large scale under modern conditions.

The wild species is believed to have been known already to Pliny and is now of wide distribution throughout the tropics of both hemispheres, but the soft hulled, edible kind, under discussion here does not appear to have been known to European writers until in the seventeenth century, though in India, its native habitat, this grain was of very ancient cultivation.

According to Watt in Commercial Products of India, the edible form of *Coix lacryma-jobi* is grown in India and in Tonkin, China, Malaya and Japan.

He states that :

Were a statement prepared of the geographical features of interest in the cultivated plants of British India, *Coix* (adlay) would have to be commented on as characteristic of the tract of country that stretches east by south from Nagpur to Sikkim, Assam, Burma, the Malaya and China, and be regarded as an important food grain with some of the most ancient aboriginal inhabitants, especially, those of Mongolian origin.

The absence of statistics shows that in a broad sense adlay is of relatively slight importance in India as compared with the major cereals, rice, corn, sorghum, and ragi, though in some regions it would appear to be of considerable importance, since WATT states that :

From Darjeeling and through Bhutan to the mountains of Upper and Eastern Assam, the Khasia, Garo, and Naga hills, etc., to Burma and the Shan States, *coix* ("adlay") might be described as not only a fairly plentiful crop but an exceedingly important article of the diet.

There are many varieties of adlay cultivated in India for WATT continues:

"There are great diversities in size, shape and colour of the grain, as also in quality and purposes to which put. * * * Certain forms are roasted, then husked and eaten whole, being either parched (like corn) or boiled as with rice. Other forms are so very different that the grain may be milled and ground to flour and thereafter baked into bread

When the Chinese general Mayuen invaded Indo-China in the first century A.D., he became so fond of the adlay grown in Annam that he introduced it into China, where it is still cultivated.

Aside from the uses of adlay for food already mentioned, in China the grain is eaten in soup like pearl barley which it very much resembles in appearance.

As grown in the Philippines the adlay is represented by several very distinct varieties. In colour the grains run from white through various shades of gray and brown to almost black; in shape they are roundish to oblong, almost like a plump oat grain; in size, they are not more than 6 millimeters in some varieties, with up to 15,500 or more grains to the kilo; while others are over 10 millimeters long and less than 3,500 grains to the kilo.

Very little adlay is grown anywhere, but there is probably more of the grain grown in Bukidnon, Cotabato, and the Mountain Province than anywhere else, though some grain is also grown in the mountain district of Cavite, Rizal, and Laguna.

The first attempt to ascertain the yield of adlay in the Philippines was made in 1918 in Zamboanga. This yielded at the rate of 3,625 kilos of grain to the hectare. A second trial at the Lamao Experiment Station in the following year returned a yield of 1,635 kilos of grain, and 4,319 kilos of air dried straw to the hectare, but this low yield is believed to have been due to the seed having been sown too late in the season and the seedlings having been transplanted to the field as late as September, whereas to obtain a good yield the seed should be sown not later than July.

More recently published reports of trials with adlay in Java and Sumatra show a yield there of 2,867 and 3,528 kilos of grain per hectare, respectively. Therefore, it would appear that the yield may be conservatively estimated at 2,500 to 3,000 kilos to the hectare under proper culture.

The analysis of adlay from Bukidnon made by the Bureau of Science is shown in the following table, which for comparison also shows the analysis of various other grains and pulses.

**Analysis of Adlay and various other Cereals and Legumes.**

| Samples. | Moisture. | Protein. | Fat. | Ash. | Crude Fibre. | Carbohydrates, starch, etc., by difference. |
|---|---|---|---|---|---|---|
| | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* | *Per ct.* |
| Edible adlay (whole seed) - | 10·02 | 8·23 | 8·87 | 8·94 | 14·08 | 49·86 |
| Hulled adlay - | 10·91 | 11·27 | 6·65 | 1·89 | 0·45 | 68·83 |
| Wheat - | 10·62 | 12·23 | 1·75 | 1·81 | 2·36 | 71·18 |
| Corn - | 10·93 | 9·88 | 4·17 | 1·36 | 1·71 | 71·95 |
| Oats - | 10·06 | 12·15 | 4·33 | 3·46 | 12·07 | 58·75 |
| Rice - | 11·88 | 8·02 | 1·96 | 1·15 | 0·93 | 76·05 |
| Millet - | 11·66 | 9·25 | 3·50 | 2·35 | 7·29 | 65·95 |
| Mongo - | 9·21 | 18·30 | 0·88 | 4·23 | 4·89 | 62·49 |
| Pea - | 12·40 | 20·63 | 1·31 | 2·88 | 4·21 | 58·52 |
| Beans - | 15·25 | 19·63 | 1·72 | 3·29 | 3·54 | 46·57 |

Here it will be noted that hulled, the state in which the grain is eaten, the Bukidnon form closely approximates wheat in starch and protein content, which cereal it exceeds in fat. With a greater protein and fat content than either rice and corn it is more complete human food than either of these grains.

For comparison with the Philippine adlay the following analysis of hulled adlay grown in India quoted in DICTIONARY OF ECONOMIC PRODUCTS OF INDIA is of decided interest :—

| | Per cent. |
|---|---|
| Moisture ... ... | 13·2 |
| Albumen ... ... | 18·7 |
| Starch ... ... | 58·3 |
| Oil ... ... ... | 5·2 |
| Fibre ... ... ... | 1·5 |
| Ash ... ... ... | 2·1 |

The following analysis of the hulled grain has been obtained in Java :—

| | Per cent. |
|---|---|
| Moisture ... ... | 14 |
| Albumen ... ... | 11·25 |
| Fat ... ... ... | 2·22 |
| Carbohydrates (starch) ... | 70·40 |
| Crude fibre ... ... | 1·55 |
| Ash ... ... ... | 0·58 |

The waste in hulling has been found to be 28 per cent. in the adlay from Bukidnon in the Philippines ; in India it has been found to be 25 per cent. and in Java 30 per cent. in one and 47·5 per cent. in another analysis. Separate analysis of the various Philippine forms are not yet available but it is apparent that the small grained sorts from Bukidnon have less waste in hulling than the varieties from the Mountain Province and Cotabato with larger grains and thicker hulls.

## CULTURE.

Adlay does the best on a fairly friable, loose to loamy, fairly rich soil, and should not be planted on heavy, clayey lands. According to the observations made in the Philippines, it grows well from sea level up to an elevation of at least 1,000 meters. In India it is grown up to an altitude of 1,500 meters. The plant requires a moderate rainfall during the growing period, but heavy rains do not injure it provided the land has good drainage.

From the experiments with adlay at Zamboanga and at Lamao it would appear that in field culture adlay should be sown with the arrival of the rainy season in June and July to not later than early in August, or so that the plants have the benefit of the rainy period and can be harvested during the dry season. Planted then, a good crop can be obtained with the aid of the natural rainfall without irrigation. Three to four seeds should be planted to the hill, the hills 50 to 60 centimeters apart, in rows 70 to 80 centimeters apart. If the seed is poor more seeds should be dropped in the hill.

After the seeds have germinated the field should be cultivated and hoed like corn. Thereafter, as the plants develop they rapidly shade the ground and assist in checking the weeds rendering further cultivation unnecessary.

When the grain is ripe the stalks should be cut from 60 to 75 centimeters from the top, tied in bundles and dried and subsequently threshed and cleaned like other gains.

## SOME USES.

The tender plants of adlay make a good forage for cattle and horses, and grown for this purpose several cuttings can be obtained from a sowing. The seed should then be drilled in rows and not sown in hills as when the plant is grown for the grain.

The grain itself can be hulled and prepared as a rice substitute by an ordinary rice mill, and MR. MCCALL in Cotabato has found that where grown on a small scale the hulling can be performed by a corn grinder of the kind widely distributed by the Bureau of Education and it can be ground into grits and meal on the same grinder with the proper adjustment and regrinding the meal. In the event that the adlay should be extensively grown, flour mills would, of course, have to be imported for milling the grain.

As to the use of adlay for human food, more particularly as wheat substitute, we have found that hulled it cooks up like rice and can be so eaten: "cracked," it makes an excellent breakfast cereal; the meal mixed with equal parts of wheat flour, or two parts adlay meal to one part wheat flour, bakes into light, fragrant biscuits fully equal to graham biscuits or corn bread in palatability; biscuits made from adlay alone are of good flavour but are not so light as when the dough contains some wheat flour, hot cakes made from it are unexcelled.

It is worthy of note that the flour imports are steadily rising one year after another showing that the Filipino is gradually, if slowly, changing his food habits, and is beginning to eat wheat in place of rice. In 1919 the wheat flour imports were P8,929,176, as against P8,817,362 of rice imported.

Therefore, considering that wheat flour is already an important import item which is annually increasing in value; the many and varied uses to which adlay can be put as a human food; that the grain can be grown with natural rainfall with the aid of irrigation; that the yield is about twice that of rice with the same amount of labour; that is easier hulled than rice, that it is a more nourishing and a better balanced food than rice; and that the grain makes a capital poultry and other animal food; it is believed that adlay merits serious attention as a grain crop in the Philippines.

Readers who may wish to try adlay should apply for seed to the Director of Agriculture, Manila.—PHILIPPINE FARMER, Vol. VII, No. 3.

# AGRICULTURE ABROAD.

## AGRICULTURE IN ASSAM.

At Shillong, Assam, the Director of Agriculture recently gave a lecture to the members of the Legislative Council with the object of removing certain misapprehensions held commonly by the public. A synopsis of the lecture has appeared in the Provincial Press, from which we take the following extracts :—

"Some people say that the officers of the department do little more than draw salaries and travelling allowance. There is also the belief that there is a mysterious subject called Scientific Agriculture which can be learned in a book and applied without much, if any, practical experience. Agriculture is an art which can be learned only by long, hard practical experience : its methods may be improved by results obtained in chemistry, soil bacteriology, botany, mycology and entomology ; but the application of these results entails much more labour than before, as is evidenced by the increase in labour on tea gardens by the adoption of methods recommended by their Scientific Department. The kind of crops that can be grown depends largely on climate, and no amount of science will make the cultivation of cotton in the plains of Assam a profitable undertaking any more than it can render profitable the growing of jute in Bombay or rice in the Punjab. Our damp climate is excellent for rice, jute, tea and sugar-cane : the dry climate of the Punjab is excellent for cotton and wheat, and incidentally for the production of good cattle ; neither climate can be changed by science, and each must be accepted as the will of God.

The object of the Agricultural Department is to improve out-turns of the crops grown by the cultivator. These crops exist because they have been found by the experience of thousands of years to be suitable to the climate and soil. It is a waste of time to think of introducing new crops from elsewhere before an effort is made to improve what is actually found growing. Rice is the main cultivator's crop of Assam, and is followed by sugar cane and jute.

There are three possible lines of improving the out-turns of these crops : (1) better cultivation by the use of larger ploughs and other implements, (2) the application of manures, (3) the use of better seed. It is the experience of every Agricultural Department of India that the readiest and most successful method of improvement is the use of better seed. In Assam the introduction of larger implements is prevented immediately by the small size of the bullocks ; if the latter could be increased in size, it is not improbable that the first result of deep cultivation would be a *decrease* in the out-turn of crops from the raising of sub-soil, and the cultivators would be

disheartened. The use of manures is restricted by their high prices ; for instance bonemeal, which improves the out-turn of over-cropped rice land by 30 per cent., is now Rs. 6 per maund as compared with Rs. 3 before the war; green manures, such as *dhaincha*, which are grown to the height of a couple of feet and then hoed or ploughed into the soil before the main crop, such as rice, is put in, are restricted partly because in a season of heavy rain they do not grow well and partly because the cultivators so far consider their use as too troublesome, though the cost of the seed is trifling. But an improved seed costs no more in money or labour than an inferior seed, and is readily accepted once its superiority is proved.

In Assam we aim now at producing improved rice, jute, sugar-cane and potatos ; the only implement that has met with real success is the three-roller iron sugar-cane mill.

The first thing to do towards any improvement is to experiment ; these experiments are made in our experiment stations, commonly called experimental farms. It is urgently necessary that there should be a clear idea of what an experiment station is : it is a farm on which experiments are made with the object of ascertaining what improvements can be recommended on land in similar situations and with a similar climate : if, out of ten experiments made even one real improvement is discovered, the farm is a success, for its object is to ascertain what can be recommended and what cannot be recommended, and it has been found in the example that nine of the experiments made cannot be recommended. Of course the experiments are made by experts who try only what is *prima facie* probable, and so are restricted in their nature and number. The illustration given above is deliberately exaggerated in order to bring out clearly the point that experiment stations cannot be run at a profit ; if we knew beforehand that any experiment would be a success, it would be unnecessary to make the experiment ; it is just as reasonable to expect a medical research station, like that at the Pasteur Institute, to pay a profit as it is to expect an agricultural experiment station to pay. The successful results obtained are then shown to the cultivator on his own land under his own conditions of cultivation and his own methods of work ; this is called a demonstration and is effected by a "demonstrator." The latter works under an Agricultural Inspector, of whom there are now one for each district in the Assam Valley and Cachar, and one for each sub-division in Sylhet.

The experiment stations must also be carefully distinguished from the terms "model farm" and "demonstration farm." Practically speaking a "model farm" is a misnomer : if we had a farm held up as a model for the cultivator we should use implements and manures beyond his power of purchase, and he could not imitate our methods : he would naturally say that it is easy for Government to spend money lavishly, but a poor man cannot afford it. Other people think that a model farm should show that agriculture can be adopted as a profitable profession : but we know that 85 per cent of the population of Assam already make a living from it, and hence it is unnecessary to show that it is profitable : the object of our department is to

make it more profitable than it is now. A demonstration farm would show the successful results obtained on the experiment stations but is open to the same objection from the cultivator's point of view as the model farm, i.e., that it would be run by Government, and he would have no confidence that he would find the recommendation profitable. What we do is to turn his own land into a demonstration farm, where he works himself and with his own implements, and where there can be no deception or doubt of the results which he obtains in his own mind or that of his neighbours.

Everyone knows that the cultivator is conservative, timid and almost a fatalist : in this he is like farmers all over the world. In Assam he is usually illiterate, and is unfamiliar with outside ideas. At the beginning he distrusted our department because he cannot understand why Government should want to improve his crop unless it intends to increase his revenue or to impose some tax ; he looks upon our Inspector as *bhadralok* who are estranged from agriculture and cannot know what he has learned from his father and his own hard experience. At first when we persuade him to try an improved seed he waits until he has put out all his own seed and then at the very latest moment and on the worst piece of his land he tries our seed. He is, however, not only not a fool, but generally a clever man at his own work, and so he knows that he has not given our seed a fair trial : at the same time he is quite right not to take on trust what we tell him until he has proved on his own land that we are speaking the truth. When therefore he finds in spite of the bad treatment he has given to seed that it does fairly well he generally decides to give it a fair trial next year, and once he is convinced his neighbours follow his example. We distribute free our good varieties of rice in 5 seer packets ; each seer will produce a maund of dhan, and as the people usually exchange (not sell) dhan seed there is ample in the 5 seer packet to cover a very large area in a couple of years.

As an indication of how the cultivators are increasingly gaining confidence in the department it may be mentioned that we have two Seed Depots at Gauhati and Sylhet from which we sell for *cash* payment only seeds, manures and implements ; the depot at Sylhet was opened only at the end of 1918. The following are the cash receipts for these two depots for the last 2 years and 9 months :—

1918-19 (6 months) equal to Rs. 1,130 per month
1919-20 (12 months) equal to Rs. 2,660 per month
1920-21 (12 months) Rs. 60,000 equal to Rs. 5,000 per month.

The above receipts came almost entirely from the ordinary cultivator, and considering his conservatism, usual shortness of capital and general dislike to pay in cash, can be claimed as a clear proof that his confidence in the department exists and is increasing every day.

Members of the public who wish for information or to see any practical work in the field should apply to the Deputy Directors at Jorhat and Sylhet, to the Superintendent in charge of the seed depots at Gauhati and Sylhet, or to the Agricultural Inspector at the headquarters of each district, and of each sub-division in Sylhet only.—Indian Scientific Agriculturist, Vol. 2, No. 5.

# SOILS AND MANURES.

## LIME AS A FACTOR IN SOIL IMPROVEMENT.

The following article by MR. R. S. CUNLIFFE, B.Sc., is of interest. It may be mentioned that recent work has shown that some of the so-called lime-loving plants thrive best on limestone soils, not because of the presence of lime itself, but because the water conditions are such as to render these soils unattractive to plants in general :—

As the use of lime as a factor in the improvement of soil conditions in the West Indies has been deemed in the past by planters to be of considerable importance, it may be of interest to draw attention to a few of the problems connected with liming, and the present status of knowledge, derived from experimental data and otherwise, on the subject.

The value of lime in agriculture generally, has been demonstrated by practical experience for a very long time in many countries, and under different soil and crop conditions, and the scientific questions involved in its correct and economical use are revealed to be of such a complicated and far-reaching character that further investigation of the subject, especially in the tropics, is a matter of major importance in crop production and soil improvement, and particularly so in those colonies where liming has become a well-established practice in recent years, apparently with beneficial results, but without much thought or idea as to what ultimate conditions may arise from the—in some instances at least—free use of lime materials.

The underlying scientific reasons for the need of lime, and the functions performed by it in the plant, are still matters of wide difference of opinion among investigators. This discussion ranges over the questions : Is there free acidity in the soil? What is the relative of free acid to lime or other base? What tests, if any, constitute an adequate measure of the need for lime by a particular soil type? Is free acidity itself the limiting factor, or is it correlated with some other condition? Whatever may be the answer to such question, the opinion is quite generally held among investigators, that the need for lime is associated in some way, directly or indirectly with an acid condition of the soil as measured by the absorption of a base.

As regards the range of tolerance by different crops of an acid or alkaline condition of the soil, very little is definitely known, but a wide variation is shown by the behaviour of certain plants under acid neutral, or alkaline conditions. Some plants have a wide range of tolerance, others not so ; and apparently this applies not only to the higher plants, but also to micro-organic life species, whether of a normally beneficial or detrimental character ; an aspect of the matter nevertheless of great practical importance. Certain it is that plants cannot be divided sharply into two classes, one of which will thrive under acid soil conditions, the other under an alkaline reaction.

Rather does the available data show every gradation of tolerance among plants ; and herein arises another point. Too often it is assumed, that for plants which thrive on a soil close to the neutral point, too much carbonate of lime cannot be added to the soil. As has been shown by some field results, however, the question might very properly be asked, whether the alkaline tolerance of plants may not be quite as important to determine as their tolerance of acid conditions in the soil.

Coming to the application of lime materials, including both the caustic and the carbonate forms, two classes of problems present themselves, viz.: (1) What are the effects of equal or equivalent amounts of these two forms of lime. (2) What are the relative practical aspects of the use of these different materials? Closely connected with such questions, we have those of the relation of lime to the availability of phosphorus and potash, and the ultimate relation to the store of nitrogen in the soil, as well as other bio-chemical factors of less direct practical interest. Our knowledge of such points, however, is far from reaching definite conclusions.

Much information of a more or less indefinite and mis-leading character has been disseminated with regard to the relation of different forms of lime to soil organic matter, little or no distinction having been drawn between purely chemical reactions and those of a biological nature. The idea commonly held that caustic lime is especially destructive of organic matter, has usually been conceived as a more or less purely chemical process, which theory has been generally extended to inhydrated lime, because of its caustic properties. Unquestionably chemical reaction takes place, but that this is truly destructive of valuable humus, has not been demonstrated. The chemical and biological relations of the problems are of considerable practical value, as on the satisfactory solution of such, rests the answer to the question as to whether caustic forms of lime, in suitable amounts, may or may not be better than carbonate forms. What, for instance, are the effects of caustic and carbonate forms of lime on the granulation and porosity, and related problems of different soils? Are these effects the same, or do they differ with different kinds of soil? Available data indicate that the caustic forms are the more active in this respect, while the carbonate are either nearly inactive, or produce in some soils an unfavourable reaction. Does such data as exist on this point furnish the ultimate reply to such questions?

Closely connected with the above is the question as to how long caustic lime remains as such in the soil. Recent experimental work indicate that the period of recarbonization is very short. Some investigators also indicate that certain silicate forms of lime are capable of exercising almost the same functions as carbonate, which is of interest as regards the use of such forms as basic slag. This matter of the value of silicate forms and similar combinations is again closely connected with the question of fineness of lime materials applied to the soil. If lime in such forms of combinations, is just as effective as the carbonate form, it would then seem permissible to apply those forms of lime which most readily form such combinations, namely, burnt lime, and very finely ground carbonate. Again, such silicate forms suggest the precipitation of colloidal silicates, a milder alkalinity, and a conservation of lime materials in the soil without interfering with their usefulness.

Connected with the question of fineness of division is that of the movement of lime through the soil, and the possibility of loss from leaching. The analysis of the soil of one of the fields at Rothamsted shows over 3 per cent. of carbonate of lime in the first 9 inches, but none in the second, a result that appears to be due to the application of chalk to the land so long ago that the record is lost. This would indicate, in this instance at least, how slow is the movement of lime materials.

Again, as regards the question of degree of fineness to which limestone should be ground, so as to perform the full functions of such material within the period for which it is applied, the practical data are very meagre. How coarse may such material be applied without sacrificing its efficiency? Observations on some calcareous soils reveal a re-action distinctly acid to litmus, notwithstanding the presence in such soils of particles of carbonate of lime. The question of suitable fineness cannot be regarded as settled in any sense, and to advise the use of a sufficient amount of coarsely ground material, on the chance that there may be enough finely ground substance to supply the needs of the soil, runs into economic questions, and that of how far the time element may compensate for lack of fineness.

It will be observed from these few notes that the question of caustic *versus* carbonate of lime, fine *versus* coarse materials, calcium *versus* magnesium, and the amounts necessary for particular crops under varying conditions of soil and climate, as well as other problems directly or indirectly connected with liming, have at least been imperfectly investigated. Practical work in this respect is largely as yet on an empirical basis, and until more accurate scientific data are available, it would seem prudent to proceed with caution in the indiscriminate use of lime materials.—AGRIC. NEWS, Vol. XX, No. 495.

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## POTASSIUM AND PLANT GROWTH.

Although many experiments have been made, all showing that potassium salts are essential to the normal growth of plants, there is still ample scope for further investigations with the object of ascertaining the precise effects which result from the lack of potash salts in the soil. It is, of course, well known that a deficiency of salts of potassium soon makes itself apparent by a withering and dying of the leaf-tips. It is also recognised by growers that the presence of adequate supplies of potassium salts in the soil helps the crop to stand up better in dry weather and may make the difference between success and failure of a crop grown on light soil in a dry year. This subject, of no less theoretical than practical importance, has been investigated recently by MESSRS. T. O. SMITH and O. BUTLER* with very interesting results. They show that the effect of a defective supply of potassium salts make their appearance at a very early stage of the growth of the seedlings; in the case of Wheat (Blue Stem) within 13 days of germination. The symptoms of potassium hunger were a drying of the tips and an irregular

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* "Relation of Potassium to Growth in Plants." *Annals of Botany*, Vol. XXXV No. CXXXVIII, April, 1921.

crinkling of areas of the older leaves. Another symptom manifest after 19 days from germination was the absence of tillering (stooling) which was taking place in plants supplied with a complete soil solution. The browning effect usually attributed to a lack of potash caused by degeneration of chlorophyll was not, however, observed at this stage. After about three weeks the plants grown in the absence of potash were analysed and the results compared with those obtained from the analysis of "controls" supplied with potash. It was found that the total dry weight of the potash-starved plants was more than five times less than that of the "control" plants. It was also manifest that the tops had suffered less than the roots—the former weighing only some 4½ times less than the tops of plants grown in a potash-containing medium. Similar experiments with Corn (Zea Mays) gave similar results, except that the check to growth was noticeable rathar less precociously in the plant lacking potash than was the case with Wheat. Buckwheat, on the other hand, grown without potash suffered complete arrest of growth on the twelfth day, and whereas at that time the plants possessed only one joint and one small leaf, those supplied with potash had four nodes, well-developed leaves, and were coming into flower. A peculiarity in the distribution of potash was observed in this plant. Whereas in the case of Wheat and Corn the tops and roots have approximately the same amount of potassium per unit of dry weight, in Buckwheat the roots of plants able to absorb potash are much richer in potash than are the stems. It would, therefore, appear that the reason why the growth of Buckwheat deprived of potash is even more puny than that of Wheat and Corn is that it does not distribute evenly the small traces which it is able to get—the roots taking far more than their share. Equally instructive are the results of the experiments carried out by MESSRS. SMITH and BUTLER with a view to ascertaining whether a plant deprived of supplies of potassium in its early stages of growth is able to recover when salts of this element are supplied to it. The experimental answer to this question is an emphatic negative. After three days' abstinence from potassium, a seedling plant, though it may regain health, does not regain its normal vigour even though it be supplied with plenty of potassium salts, and its root system in particular remains poorly developed. If the plant be subjected to six days of potash starvation, subsequent additions of potash to the medium in which it is growing do not "cure" it, and the plant remains stunted. It has usually been held that one of the important uses of potash salts in the plant is that of facilitating the distribution of the sugar formed in the leaf and its accumulation in storage organs. The experiments of MESSRS. SMITH and BUTLER do not, however, lend support to this view. A very curious and interesting difference in behaviour of Wheat and Corn seedlings was observed. Whereas lack of potassium during the first six days of its life resulted in the case of Wheat in a loss of 62 per cent. of its weight, Corn in this period showed no loss at all, although it failed to develop properly if potash was withheld for a longer period. It looks as though—as the authors point out—one of the roles of potassium is to enable the plant to make some substance necessary for growth, and that this substance exists in greater quantity in the seed of Corn than it does in that of Wheat. The practical value of these observations scarcely needs emphasis. Cultivators must take care, if their soil be one which is poor in potash, to see this lack is made good before the crop is sown, for otherwise their plants may receive a check from which they are not likely wholly to recover.—GARDENERS' CHRONICLE, Vol. LXIX, No. 1794.

# PHOSPHATIC MANURES: THE PRESENT POSITION.

Since the beginning of the year the Agricultural Press has been emphasising two aspects of the supply of phosphatic manures. They are (1) that although official figures show a considerable increase in the production of basic slag it is likely that there will not be sufficient this season to meet the total demands of the farming community; (2) the fact of the production of superphosphate being in excess of the present demand for it may result in large quantities being exported, on account of the congestion at the works. It is natural for the farmer to enquire how these conditions are likely to affect him, and what he should do to meet them.

Three courses present themselves. The first is to discriminate in the use of basic slag. Requirements per acre are greater now than they have been, because the grades of slag quoted range roughly from 16 to 32 per cent. total phosphates; few range above that figure, and several are below it. When it is remembered that a few years ago high grade slags approximated to 40 per cent, total phosphates, it is obvious that dressings of a 20 per cent slag must be doubled in quantity to effect the same improvement. Industrial conditions resulting in short time being worked in the steel works may prove a further factor in limiting output. It would seem important, therefore, to confine the use of slag mainly to grassland, and make up the phosphates required elsewhere by dressings of other manures. There are cases where slag appears to confer no benefit on poor pasture, and it seems questionable whether, where that is so, any other form of phosphatic manure would do better. It is worth mentioning, however, that an absolute lack of potash in some soils may prevent any visible result from dressings of phosphates, while on other soils a rough, matted and fibrous covering greatly handicaps the slag in reaching the soil. A very thorough harrowing is imperative to see this condition right.

The second consideration is the possibility of substituting superphosphates for basic slag in order to take advantage of the state of supplies Local experience or experiment may prompt the use of superphosphates on grassland in place of slag. Approximately $5\frac{1}{2}$ cwt. of 35 per cent. superphosphate equals a dressing of 5 cwt. high-grade basic slag. Generally, superphosphate may be substituted where it has been customary to use slag in cropping; the former is more rapid in action and thus, as a rule, better suited to arable farming. In consequence of this rapidity, its maximum effect is more quickly reached, but where seeds are only down for one year, the influence of this manure applied to the nurse crop will be all that is required. Where there is hesitation to substitute superphosphate for slag altogether, the two may be mixed. Superphosphate will act rapidly on soil with a good lime content.

Thirdly, there is the use of phosphatic manures other than those already discussed. A review of experiments conducted in this country shows that finely ground mineral phosphate is valuable in the North of England and also in Scotland and in Wales. Good results have also attended its use in Essex, and has been applied also with benefit in other districts, notably in those with a high rainfall, and on soils rich in organic matter.

The following is a brief resumé of some of the more important experiments on which records are available :

Aberdeen 1905-1907, Turnips, Barley, Hay.

In a series of experiments extending over 3 years, the effect of different, forms of phosphate, viz., superphosphate, basic slag, bone meal and ground Florida phosphate applied alone and with dung was tested on turnips followed by barley and hay. In the "no dung" plots, both super and slag gave somewhat better returns than mineral phosphate, but when dung was used the mineral phosphate gave the greatest total value of crops and considerably the highest profit

Experiments in *North Wales* also indicate that rock phosphate is distinctly effective. At six centres the yields of swedes were, on the average of three years 1913-1915, per acre :—

| | Tons. | Cwt. |
|---|---|---|
| No Phosphate ... ... | 13 | 1 |
| *Basic Slag (482 lb,) ... ... | 22 | 4 |
| *Gafsa Phosphate (333 lb.) ... | 21 | 8 |
| *Superphosphate (539 lb.) ... | 22 | 9 |

*All contained 220 lb. of phosphate.

These manures are being quoted at a low unit value at present. A mixture of finely-ground soft mineral phosphates and superphosphates may be employed for arable crops. The following quotation from an article by DR. RUSSELL* summarises the position with regard to mineral phosphates : "*Where basic slag cannot be obtained in sufficient quantity, it is worth while trying mineral phosphates, provided they are sufficiently finely ground.*" Their cheapness suggests use on rough pasture, especially the poorer, high-lying types rented at a figure which makes dressing with slag out of the question Bone meal, and especially steamed bone flour, have been showing a cheap unit value of late ; both contain a little nitrogen, and may with advantage be mixed with superphosphate.—JOURNAL OF THE MINISTRY OF AGRIC., Vol. XXVIII, No. 2.

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*JOURNAL OF THE MINISTRY OF AGRICULTURE, January 1921, p. 963.

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# PESTS AND DISEASES.

## INSECT PESTS OF COCONUTS.

**D. PONNIAH,**

(*Insectary Assistant, Department of Agriculture, F.M.S.*)

Coconut has been grown extensively in Malay from time immemorial and it holds a place second in importance only to rubber.

We are here to-day to discuss some of the more important insect pests affecting the coconut tree.

Now let us consider the pest that attacks chiefly the young plantations.

### TERMITES OR WHITE-ANTS.

This is known in Malaya as "Anai anai." The pest is more seen in young plantations where timber has been allowed to remain for two or three years. This presents a convenient nesting place for them. They breed and multiply there. From here they migrate to young coconut trees if their natural habitat is disturbed or when they run short of food.

The exact life-history of these insects has not been worked out, but their habits are fairly well known. If in some place affected by this pest, timber, which as I remarked before forms the nesting place, is removed, there appears to be a violent attack on young coconut palms or rubber trees close by.

*Control.*—Complete destruction of all timber along with the nests is therefore *the remedy* for white ants. Cleanliness in coconut plantations is a thing of supreme importance, to which all careful planters should adhere.

## PESTS OF LEAVES.

*Brachartona catoxantha* (*Hamps.*)—The caterpillars of this moth occur at more or less regular intervals of two, three or even six years in the same locality and do considerable damage by eating the under surface of the leaf, or, when they are full grown larvæ, a portion of the complete leaf-substance. A fairly well attacked coconut holding shows a dry and parched up appearance. The result of the attack is that the nuts will fall off or remain undeveloped. This is due to the leaves supporting the bunches drooping. Attacked trees do not die as a rule, but recover after some time when fresh leaves are put forth.

*Life-history.*—The life-history of the pest is as follows : Eggs are laid by the adult female moth singly, generally on the lower surface of the leaves and more especially at their tips. They are watery green in appearance, round, and about the size of a pin's head. From these eggs, tiny little caterpillars, having hairs all over the body, hatch out. These feed voraciously and grow rapidly. After about five weeks they are full grown, when they pupate inside a white silken cocoon either on the leaf or on the stem or at any other convenient position on the tree. Moths come out from the cocoons after about nine days. The upper surface of the wings is a dirty brown in colour and the body is for the most part yellow in colour.

*Natural Control.*—This pest seems eventually controlled by climatic conditions, parasites, and predators. The chief among the insect parasites is a Tachinid fly. This lays its eggs usually on the heads of caterpillars, generally one on each. The eggs hatch in three days into maggots which enter the body of the host and feed inside until the host dies. When the maggots are full fed they come outside the body of the host and pupate. They emerge as flies after seven or eight days.

A small hymenopterous insect lays its eggs inside the body of the caterpillar. The larva hatches out and feeds inside and, after a few days, is seen pupating under the body of the caterpillar. The appearance of this on a leaf *in situ* is as if the caterpillar is brooding over an egg.

A species of fungus also attacks the caterpillars and is responsible for reducing the number of the pest considerably.

*Control.*—Several remedial measures have been tried. The chief recommendation so far is to cut the lower affected leaves and burn them. This method, while reducing the pest to a degree, kills prasites as well as pests, It should be done at a time when it will be least injurious to parasites, namely, on the first appearance of the moths.

Adult moths are inactive during the night and from 9 a.m. till 2 p.m. in the daytime. During these times they can be easily collected by means of hand-nets or crushed between flatstone or wood where the trees permit.

Cultural and other methods of control are being tried but the experiments cannot be said to be conclusive at present.

*Plesispa reichei.*—This belongs to a family of leaf eating beetles. It is what was hitherto known to us as *Bronthispa froggatti.* It was noted in the Federated Malay States in 1914-1915 as a minor pest doing some damage to coconuts. It has increased in seriousness ever since. So far, parasites or predators have not been found keeping it in check. This then is presumably the reason why it is assuming serious proportions.

*Life-history.*—The whole life-history takes about two months and the whole life of the pest is passed on the tree between the just opening fronds and young leaves. Eggs are laid there, and grubs feed and pupate there. The adult beetles also are found there feeding and pairing. The adults shun light and are capable of flying when disturbed. The question of control, therefore, becomes a problem which cannot easily be solved.

It has not yet been found possible to treat them with any poison-sprays. Experiments will shortly be tried by the Department to see if any satisfactory control is possible. The only suggestion for control for the present is : To press the leaflets together between thumb and forefinger so as to kill the adult beetles, grubs, pupæ and eggs that are found between and inside the leaflet.

## OTHER PESTS.

*Coconut Spike Caterpillar.*—This belongs to a family of moths. The caterpillar of this moth attacks both male and female flowers of the spike. When the male flowers are attacked their anthers are eaten first, the dead flowers and frass being spun together with silk (which they secrete) into a dirty looking mass around the branches of the inflorescence. Tunnels are formed within this mass in which caterpillars move freely to and fro. In badly attacked places, caterpillars of various sizes of growth can be seen. When the male flowers are thus attacked and eaten away, a few caterpillars may destroy female flowers, while yet a few will migrate to other spikes when food-supply is exhausted. The caterpillar pupates in a roughly constructed silken cocoon in the mass of dead flowers and frass. The result is that nuts are generally not formed, even if the female flowers are not bored. The only treatment recommended at present is to cut and burn all affected spikes.

*Coconut Pollen Mite.*—Mites do not come under the category of "insects." They are eight legged creatures in their adult stage as against six legs of insects. These mites feed on the pollen. MR. P. B. RICHARDS records in page 417, Agricultural Bullet, Federated Malay States, Vol. VI, No. 10, as follows : "Such of the pollen as is not destroyed becomes massed into heavy lumps, and probably is rendered unfit for pollination of the female flowers." The result is the formation of a scanty crop of nuts.

## PESTS OF STEM AND SHOOT.

*Rhinoceros Beetle.*—This is what is known in Malay as "Kumbang hitam." It occurs throughout Malaya in all seasons of the year. Eggs are laid in decaying organic matter such as coconut stumps and manure heaps. From these eggs, whitish grubs with three pairs of legs hatch and feed upon the rotting vegetable matter. When full grown they pupate and emerge as adults which fly to coconut palms and by injuring the crown provide a means for the red weevil to enter for egg laying. This ranks as a very important major pest of palms and is a potential carrier of fungus diseases of palms.

*Control.*—Various methods of control have been suggested, The best among them are destroying all the possible breeding places, and is so doing eggs, grubs and pupæ, and extracting beetles by means of a wire.

The beetles are attracted to light in India but experiments conducted here have met with little success.

Poisoning rubbish heaps and traps have been suggested but the success or otherwise of these for Malaya cannot be gauged without actual test. Mr. P. B. Richards has observed a Scolid wasp, *Scolia procer*, rendering great assistance to the coconut planters in this country. The larva of this wasp is parasitic on the fat grubs of Oryctes. He also describes in one place very clearly how the mother wasp finds the grub which is lying several inches below the surface and deposits her eggs on the host (*vide Agricultural Bulletin*, Federated Malay States, Vol. VI.

*Red Weevil.*—This is what is known to most Malaya as "Kumbang merah," Males and females can be easily distinguished by the difference manifested in their snouts. The snout of the male is rather straight and thin and appears brush-like whereas the snout of the female is slender and a bit curved at the tip and without the brush. Eggs are laid in places damaged by Oryctes, i.e., at the crown, or by mechanical means to either the crown or trunk. Grubs hatch out after three or four days and when full grown they pupate inside the tree in cocoons formed of the fibrous tissues of the tree from which beetles emerge. Investigations to ascertain their habits and experiments for control are now being conducted. So far the adult beetles have been found incapable of boring into healthy stems and it seems that only when the soft tissues are exposed can they continue their ravages. This pest can do considerable damage to the "African Oil Palm," a tree which is being introduced in Malaya.

*Control.*—Adult beetles are attracted by the smell of rotting coconut stems where they lay their eggs and breed: it is suggested that lengths of palm wood kept in or near the plantation in order to attract the beetles for egg laying would be useful, but every month or less these traps must be burned, and the beetles that are attracted must be collected every morning and destroyed.

All coconut tree stumps, trunks, and soft parts, when cut down, or when they die, must be immediately destroyed. Other remedial measures which are suggested by various authorities in many countries will be tried here before they are recommended for general use in this country.

There are several species of caterpillar pests, such as skippers, bag-worms and slugs which occur as sporadic major or minor pests in some localities. They are often kept well under control by parasites or predators. It is only when natural control does not seem to operate adequately that these insects assume pest proportions. Scale insects, mealy bugs also attack our coconuts. Further researches on their life-histories, etc., should reveal means for easy control.—Agric. Bull. of F.M.S., Vol. VIII, No. 3.

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# TEA HELOPELTIS.

**E. BALLARD,**

*Entomologist, Government of Madras.*

The study of insect pests has too often been undertaken without reference to the proper study of the plants upon which they feed, and the other environmental factors affecting their life-histories. The spraying machine was looked upon as the solution of all problems, and many wild and impracticable remedies were often suggested.

Of late years there has been a world wide tendency to approach the subject of insect enemies of plants from another angle. The necessity for a complete study of the affected crop equally with the insect attacking it is more fully realised. There are many possibilities now opening out, giving those whose work it is to protect the crops, far greater hope of a successful issue to the struggle.

There is some indication that resistant varieties of at least one crop may be found, although work in this direction is still in its infancy so far as insect enemies are concerned. What is known as biological control of pests is being studied and the technique much improved, and in some parts of the world the use of insects to control insects is proving a success. There is another point from which insect pests can be assailed, and that is through the plant itself. An analysis of a particular crop might reveal some substance which may be used to bait a trap of a pest, or as a repellant to keep it away from that particular crop.

It is a matter of common observation that a sickly crop suffers more from insect pests than one which is healthy. Where more study is required is in investigating the nature of the sap in sickly plants and finding what it is that makes them more attractive to insects when they are in bad condition than when they are well. Many factors may cause unhealthiness, and what each particular kind of unhealthiness is, requires to be studied.

Mr. A. E. Andrews, Entomologist of the Indian Tea Association, has been studying for some years the problem of mosquito blight on tea, and a brief summary of the most interesting results which he has obtained are given in the Quarterly Journal of the Indian Tea Association. The experiments are still in progress, but it might be of interest to tea planters in South India to know what is being done to deal with Helopeltis in Assam. At the same time it will give an interesting side light on the sort of problem with which an economic entomologist is confronted, and how necessary it is to take into consideration all environmental factors of a crop and its enemy.

The results attained by Mr. Andrews amount briefly to this, that the resistance of tea bushes to mosquito blight is directly proportional to the available potash in the soil, and the power of the bush to assimilate it. Recently experiments have been carried to a successful issue in which bushes apparently destroyed by mosquito blight beyond recovery have been resuscitated and given a good flush. The recovery was brought about by direct inoculation of potassium salts.

Trees treated in this way have remained resistant although in the middle of others heavily infested with Helopeltis. Cases of insects alighting on the bushes and leaving them after one or two trial feedings were seen. This means that bushes so treated were actually distasteful to their worst enemy. Here, then, was a definite cause of unhealthiness, namely a deficiency of potassium salts, due either to an insufficiency of potash in the soil, or inability on the part of the plant to make use of it. This is a discovery of very great importance, for in one case at least an attractive or repellant factor has been found, and it is certainly only the beginning of a new line of study in plant pathology.

The whole problem is still under investigation, but Mr. Andrews is following up a most original and interesting line of researches, which should go far to settling the problem of mosquito blight in Assam. Emphasis must be placed on the words "in Assam," for what may solve the problem in Assam will not necessarily solve it in South India. In the first place the mosquito blight of South India is not caused by the same insect as in Assam, There they have Helopeltis *theivora*, whereas the South Indian Helopeltis is most probably *antenii*. It by no means follows then that *Helopeltis antenii* will be repelled in the same was as Helopeltis *theivora*. The writer has not yet had an opportunity of studying the problem in South India as the claims of the Pink boll worm have been paramount, but planters whose estates are afflicted by Helopeltis can solve one problem at least by sending specimens of Helopeltis so that the question *antonii* or *theivora* can be settled, and later ou as time permits, it may be possible properly to investigate the whole matter.—Planters' Chronicle, Vol. XVI, No. 23.

# APICULTURE.

## BEES AND FRUIT.

The following is taken from an article on "The Bee's Role in Fruit Culture" in the Bee World :

Some plants secrete nectar. This nectar is not a bi-product, but has a purpose, viz., the attraction of insects. It was a long time before the functions of nectar was understood by botanists. Patrick Blair thought that nectar absorbed the pollen and then fertilised the ovary. Pontedera contended that it kept the ovary moist. Linneus gave up the solution altogether. Krunitz thought that he observed in meadows much frequented by bees the plants were healthy, but the inference he drew was that the benefits of the bees' visits were they removed the nectar which was injurious to the plants. Kurr and Roltes observed that the secretion of nectar is intimately associated with the maturity of the stamens and pistil, and laid it down as a general rule that it seldom commences before the opening of the anthers, is more copious during their maturity, and ceases as soon as they wither. But none found the secret. Sprengel first pointed out that nectar attracts bees and other insects.

Lord Avebury discovered by experiments that the bee has an eye to colours, and that the bright tints of the petals act as a guide. Bees search for pollen and honey (1) to feed the young and to provide food for their own use. We make use of their hoarding instinct and secure our surplus. Bees visiting flowers for their honey carry pollen from flower to flower and bring about fertilization. It is evident that successful fruit-growing is to a great extent dependent on bee-visitation : so that the keeping of bees is an important detail in successful fruit-culture.

C. D.

## PRIZES FOR BEE-KEEPING.

The Secretary, Ceylon Bee-keepers' Association, reports :—With a view to encouraging bee-keeping in village schools three money prizes were offered for best work in 1920. 1st and 2nd Rs. 15·00 and Rs. 10·00 respectively offered by the Hon'ble Mr. F. A. Stockdale, Director of Agriculture, and the 3rd Rs. 5·00 by Mr. George Crozier of Pannipitiya.

1. The judging was done by the Inspectors of School Gardens and the results were as follows :—

1. T. K. D. Samarasinhe, Asst. Teacher, Molagoda in Kegalle District.. ..... Rs. 15·00
2. D. S. Karunasekere, Head Teacher, Potuwatawana in Chilaw District..... ,, 10·00
3. Don Edwin Solomon Jayasinhe, Monitor, Kottapola (Hakahinna) in Kegalle District..... ,, 5·00

# GENERAL.

## DEPARTMENT OF AGRICULTURE, CEYLON.

## RULES GOVERNING THE AWARD OF PRIZES IN VEGETABLE GARDENS COMPETITIONS, CEYLON.

### GENERAL.

1. These competitions are being instituted in order to stimulate the production of vegetables in the gardens of villagers and to improve the methods of cultivation employed.

2. For the purposes of these competitions, a vegetable garden shall be defined as an area of land cultivated in not less than six kinds of annual vegetables, food crops, or curry stuffs, and containing no systematic cultivation of any perennial agricultural crop.

3. Competition shall be restricted, so far as is possible, to *bona fide* villagers who are owners or lessees of not more than 10 acres of land.

4. Excepting it be otherwise notified, each competition shall be restricted to one pattu or korale.

5. Gardens of less than one quarter of an acre or of more than 4 acres in area will not be eligible for competition.

### ENTRIES.

6. Villagers who intend to compete should give their names and details concerning the area and situation of their gardens to the Agricultural Instructor of their pattu not later than three months before judging is fixed to take place.

7. Entries shall be forwarded, as soon as received, to the Divisional Agricultural Officer, or to the Chairman of Food Production Committee, where such an agricultural officer has not been appointed.

8. Agricultural Instructors shall take steps—

(1) To encourage villagers to compete ;

(2) To visit gardens before the date of judging in order to give advice to competitors ; and

(3) To ascertain whether each competitor is a *bona fide* villager as defined in these rules.

### JUDGING.

9. Preliminary judging shall be carried out by an officer of the Department of Agriculture, who shall submit to the Divisional Officer or the Chairman of the Food Production Committee, where a Divisional Agricultural Officer has not been appointed, the names of the six competitors whose gardens are, in his opinion, most deserving of further consideration.

10. The six best gardens shall be visited and inspected by a committee consisting of the Mudaliyar of the pattu or korale, an officer of the Department of Agriculture, and an agriculturist. This committee shall submit their final recommendation to the Food Production Committee of the District

11. Judges shall be guided by consideration of the following points when inspecting gardens :—Varieties of vegetables cultivated ; system of cultivation ; drainage ; manuring ; estimated yield ; freedom from disease and pests ; tilth of soil.

**PRIZES.**

12. First, second, and third prizes in money, together with certificates from the Department of Agriculture, shall be awarded to prize winners in connection with each competition.

13. A winner of a first prize shall be debarred from competing in another competition for one season subsequent to his winning the prize.

14. Winners of second or third prizes may register in the following season for competition for prizes of a greater value than the prize previously secured.

F. A. STOCKDALE,
Director of Agriculture.

Peradeniya, June 10th, 1921.

## VEGETABLE GARDENS COMPETITIONS IN GALLE DISTRICT, 1921.

The Department of Agriculture allocated Rs. 300 to the Food Production Committee of Galle District in 1921, to be used for providing prizes in connection with Vegetable Garden Competitions. It was decided to divide the sums equally between the six pattus of the District, but eventually it was not found feasible to include Hinidum Pattu, and at a later date the entries from Bentota-Walallawita Korale were all withdrawn owing to persistent drought which prevented the Gardens from being cultivated.

Finally the following entries were received from the four remaining pattus.

| | | | |
|---|---|---|---|
| Four Gravets | ... | ... | 76 |
| Talpe Pattu | ... | ... | 28 |
| Wellaboda Pattu | ... | ... | 27 |
| Gangaboda Pattu | ... | ... | 13 |
| | | | 144 |

The sum of Rs. 75 was available for each pattu, and it was decided to award three prizes in each pattu, a first of Rs. 35, second of Rs. 25 and third of Rs. 15. There were therefore 12 prizes available for the whole district, a fairly high proportion considering the number of entries.

All the entries in each pattu were inspected by the Agricultural Instructor for the pattu about one month before final judging, and the six gardens which in the opinion of the Instructor were best were afterwards inspected by a committee composed of the Divisional Agricultural Officer,

Southern Division, and the Mudaliyar of the pattu concerned. This committee then made recommendations to the Food Production Committee for the award of the first, second and third prizes.

The prize winners in the respective pattus are given in the following list.

| | | *Addresses.* |
|---|---|---|
| | *1st Prizes.* | |
| Four Gravets | D. A. D. S. Wickremesinghe | Wataraka East |
| Talpe Pattu | Hinetigala Kanattege Jeeris Appu | Talgampola |
| Wellaboda Pattu | W. M. Udari Hamy | Gonapinuwala |
| Gangaboda Pattu | Vitanachchige Dinis de Silva | Ganegama |
| | *2nd Prizes.* | |
| Four Gravets | N. A. Carolis | Wataraka East |
| Talpe Pattu | A. Wijesekera, Buona Vista | Unawatuna |
| Wellaboda Pattu | Dasim Thabreus | Idantota |
| Gangaboda Pattu | Welivitigodage Harmanis | Akmimana |
| | *3rd Prizes.* | |
| Four Gravets | Mahawanni Achchige Sinno Appu | Wataraka West |
| Talpe Pattu | 1 Ellewala Kankanange Carolis Appu | Talgampola |
| | 2 Bentota Gunaris Appu | Talgampola |
| Wellaboda Pattu | K. T. Simon Hamy | Gonapinuwala |
| Gangaboda Pattu | Charles Jayasekera | Ganegama |

The third prize in the case of Talpe Pattu was awarded jointly to the two competitors named, as the judges could not decide between the two gardens, and the Food Production Committee has been asked to increase the amount awarded in each case to the full amount (Rs. 15) of a 3rd Prize.

In each case the judges recommended that the prizes should be awarded on some public occasion, and arrangements are being made for the presentation to take place at the Galle District Show in August.

## GENERAL OBSERVATIONS.

At the time when these competitions was announced no rules existed for the guidance of competitors and judges. In consequence the entries were in some cases unsatisfactory. In each pattu a fairly high proportion of the entries were from owners of large areas of land, who in fairness should not be allowed to compete against the *bona-fide* labouring villager, and it was necessary to rule entries of this kind out of the competitions.

There was a great diversity in the size of the gardens exhibited ; while most of the entries ranged from one-quarter of an acre to 5 acres, in some cases areas of over 20 acres were offered, and in one or two cases areas of 80 to 100 acres. In all cases these large holdings were ruled out of competition, although the entrants might fairly claim that no information was given them beforehand on the subject.

Several holdings were entered in each pattu which consisted of fields of rubber or coconuts 2 or 3 years of age interplanted with a single food crop, usually manioc. These were ruled out both on the ground that they could not be regarded as vegetable gardens, and because their nature and area proved them to be the property of capitalist owners and not of *bona fide* villagers.

Draft rules for vegetable gardens competition in the Southern Division have now been drawn up by the Divisional Agricultural Officer and will be used by the Department of Agriculture for use in connection with competitions of this kind in future years. This will probably be of value in giving

competitors, instructors and judges a clear conception of the aims of these competitions, and the result should be an increase both in the number and quality of the entries.

There appears to have been in the past a tendency towards granting prizes in these competitions merely as a reward for having established a vegetable garden. This point of view was perhaps unavoidable, as the aim of the competition was in the beginning the increasing of the areas under food-crops, but the result has been that there is little true competition. The real value of competitions of this kind lies in the opportunity they afford for rewarding really good work resulting in increased yields, and for giving instruction to villagers so as to improve their methods. When correctly used they must be ranked as among the very best means we possess of imbuing the villager with a desire for improving his agricultural knowledge and for providing him with that knowledge.

G. G. AUCHINLECK,
Divisional Agricultural Officer, Southern.

## UNITED STATES GROWN SISAL.

The following announcement regarding the desirability of increasing the production of sisal fibres in territory governed by the United States is of interest. It is taken from *Bulletin No. 390*, issued by the United States Department of Agriculture : —

Important agricultural and manufacturing industries of the United States are now largely dependent on supplies of imported raw products. Necessary action should be taken to safeguard our future supply of these products.

The grain-producing industry of the United States cannot be maintained without the use of harvesting machinery, and this machinery cannot be operated without binder twine.

The greater portion of the binder twine used in the United States is manufactured from henequen and sisal fibres, and more than 90 per cent. of the total supply of these fibres imported into the United States is received from Yucatan.

This dependence of our most important agricultural industry on one small State of a foreign country constitutes a grave menace to American agriculture.

In order to remedy this situation, it is essential that an increased supply of binder twine fibre be produced within the territory of the United States, or in countries over which the United States exercises political control.

The Philippine Islands possess the requirements necessary for the development of a flourishing sisal industry.

The production of binder twine fibre in the Philippine Islands has been restricted in the past by reason of the antiquated methods that are in general use by the planters, and a number of reforms in this industry are urgently needed.

For the last three years the United States Department of Agriculture has been co-operating with the Philippine Bureau of Agriculture for the purpose of encouraging the increased production of binder-twine fibre in the Philippine Islands.

The more important lines of work undertaken have been the introduction of machine cleaning to replace the unsatisfactory retting process, the distribution of sisal plants, and the introduction of improvements on the plantations.

As a result of this work, machine cleaning has been established on a commercial basis, and twelve large modern fibre-cleaning machines have been purchased by Philippine planters during the last eighteen months; 500,000 sisal bulbils have been imported into the Philippine Islands from the Hawaiian Islands; and there is now enough sisal in the Philippines to furnish an abundant supply of plants for future use. While there has been no marked and widespread improvement of conditions on the plantations, there has been a fair degree of progress.

The production of magney and sisal fibres in the Philippine Islands for the first five months of 1920, has been larger than during any similar period in previous years. During this period, the production of Philippine magney and sisal has been approximately 20 per cent. of the henequen production of Yucatan.—AGRIC. NEWS, Vol. XX, No. 495.

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## MULCHING INSURES MOISTURE DURING THE DRY WEATHER.

**EULOGIO N. PEREGRINO,**

*Agricultural Assistant.*

Failures with crops are due mostly to drought. Plant diseases and insect pests can be remedied by spraying; the growth of weeds can be checked or prevented by cultivation; but when dry weather comes the average farmer has no means of supplying the moisture necessary to secure good maximum yields.

Good yields from the farm are certain, however, whenever an efficient method of protecting the plants from drought is practised. Moreover, results are obtained at the minimum cost, for a small area of land producing at the maximum requires a lower seed and labour expense than a large area giving a poor yield.

If water cannot be supplied inexpensively to the entire area planted a part of the crops can be protected by mulching.

There must be some means of keeping the soil cool, when water is applied during a severe drought, for wet soil intensely heated scalds the roots of the plants. There must be a protective covering between the soil and the hot rays of the sun. The dust mulch used to conserve moisture after a rain is not adequate during intensely hot weather.

Whatever is used as protective covering must be finely pulverized so that a compact coating can be made over the soil. Experiments with various materials have proved to conserve the most moisture possible and keep the ground cool. The object should be to make as much water as possible available to the plant instead of permitting the greatest part to evaporate. Straw and manure so fine that it can be easily handled with a scoop are ideal materials for mulching.

Judgment is needed when mulching should be applied For the application of the mulch in the case of any crop, there is no definite time which is best, for much depends upon the weather Frequent cultivation should take the place of the mulch while the crop is young and the soil contains plenty of moisture ; for after the mulch is in place weeding must be done by hand instead of with cultivators. It is best to cultivate until the plants are out of danger of being harmed by weeds. The application of compact mulch will have a tendency to discourage further weed growth. In the case of low-growing crops the best time for mulching is generally when the plants are started, soon after transplanted and when about half grown.

Experiments with mulches have proved that if materials containing large quantities of nitrogen are used on a soil rich in nitrogen, acid phosphate and potash must be added in order to have a balanced plant food. Applying highly nitrogenous mulch to plants induces an extraordinary growth of foliage without giving a proportionate yield of fruits. Whenever water is applied it carries nitrogen from the mulch into the soil.

The best time to apply water to plants is in the evening or during cloudy days. The greater the moisture content of the atmosphere the better the time for watering. Often, during a period of very severe drought, there will be a number of cloudy days and such a time is ideal for stimulating growth. There is no need of a great quantity of water. Watering can be easily overdone, as stems and foliage must not contain moisture in an excessive proportion to that of the atmosphere. In an experiment during an unusual drought only two waterings were necessary to maintain normal growth.

This method of conserving moisture is far superior to maintaining a dust mulch. Crops that are mulched and watered retain their freshness while others become parched and often finally succumb.

Hand weeding and cultivation are not necessary after the mulching is in place. The labour required in growing crops by this method is about the same as when cultivation is practised the entire season. Mulched crops need no attention at any particular time but with unmulched ground, cultivation must take place after a rain as soon as the surface of the soil begins to dry in order to prevent crusting.

What work is necessary can be done when no other work is pressing.—PHILIPPINE FARMER, Vol. VII, No. 3.

## PRESERVATION OF BANANAS AND OTHER FRUITS.

Recent experiments conducted at the Jodrel Laboratory, Kew, have proved the efficacy of Formaline as an agent for preventing the rapid decay of ripe fruit. Bananas treated by immersing for ten minutes in cold water containing 3% of commercial formaline lasted ten days longer than untreated fruit. Tests with currants, plums, grapes, strawberries, etc., gave similar results.

It is recommended for fruit which are eaten entire, e.g., strawberries, that after immersion in the formaline they be placed for five minutes in cold water, and afterwards placed on wire-netting to drain and dry. But with fruit with a rind better results are obtained when this is omitted.—PRO. OF AGRIC. SOC. OF TRINIDAD AND TOBAGO, Vol. XXI, Part 2.

# LIBRARY.

## THE DISEASES AND PESTS OF THE RUBBER TREE.*

This work by Mr. T. Petch, Botanist and Mycologist, Ceylon, has recently been published. It is a complete revision of a portion of the author's former work The Physiology and Diseases of Hevea Brasiliensis published ten years earlier, and brings up-to-date all the information available concerning the diseases of the rubber tree.

To the investigation of rubber diseases the author has devoted a very considerable amount of his time during the past fifteen years and his authority on the subject is recognised throughout the rubber-growing tropics. The book is full of detailed information and is intended for the rubber planter. Technical botanical details have been avoided as far as possible.

The first portion of the book deals with general sanitation of rubber estates and refers to such important matters as jungle stumps, thinning out, intercrops, protection from wounds, etc, and details the various parasitic fungi which may spread and cause damage if attention is not given to general sanitation.

Root diseases are dealt with in full detail. They are most important to the rubber plant and have probably accounted for greater loses in rubber estates than any other group of diseases. Six root diseases caused by *Fomes lignosus*, *Poria hypobrunnea*, *Fomes lamaoensis*, *Fomes pseudo-ferreus*, *Ustulina zonata* and *Sphærostilbe repens* are described, illustrations given of their general characteristics and control measures detailed.

Leaf diseases are described in Chapter III and the possible seriousness of the South American Leaf disease and of the Leaf-fall disease of the East indicated. Phytophthora diseases are dealt with in full detail and include leaf-fall and pod disease, Claret-coloured canker and Black thread (Bark rot).

Stem diseases described, other than those caused by Phytophthora include Pink disease, Ustilina, die-back, top canker, mouldy rot, thread blight, horse-hair blight etc., while Brown-bast, nodules and other non-parasitic diseases are discussed and some of the defects of prepared rubber dealt with.

The Chapter on Pests includes details concerning termites, the rubber leaf mite, the root borer and the locust, in addition to numerous other insects which are to be found on rubber, but which occasion but little damage.

The book is full of information required by the rubber planter and should be purchased by every rubber estate superintendent. It is illustrated by six coloured Plates and 38 text figures prepared in the mycological laboratories of the Department of Agriculture, Ceylon.

* *The Diseases and Pests of the Rubber Trees* by T. Petch, B.A., B. Sc., Macmillan & Co., London, Price 20/- net.

# AGRICULTURAL PRACTICE AND ECONOMICS IN THE UNITED PROVINCES.*

The book by DR. MARTIN LEAKE, Director of Agriculture of the United Provinces, India, is based upon the lectures delivered by the author when Principal of the Cawnpore Agricultural College.

It constitutes a valuable contribution to the study of Indian Agricultural Economics and emphasizes the inter-dependence between agricultural practice and economic application. It is divided into five main sections—the origin of agriculture, the basis of agricultural practice, the basis of agricultural economics, the development of agriculture and the development of agricultural economics. The book is worth the careful study of all interested in agricultural development, and particularly by those students of agriculture and economics, who are desirous of assisting in the improvement of the agriculture of their country, province or district.

It is emphasized that the development of an improved agricultural practice is intimately bound up with the economic aspect, mainly with the provision of capital. The problem of agricultural capital is dealt with in detail and the system of co-operative credit lucidly described. It is explained that the system of co-operation diminishes the risk, increases the guarantee, reduces the cost of enquiry and places capital at the cultivators' disposal on economic terms. When satisfactory credit has been provided agriculture progresses and improves.

# MANUAL OF TROPICAL AND SUB-TROPICAL FRUITS.†

This book by WILSON POPENOE, Agricultural Explorer of the United States Department of Agriculture, brings together available information concerning the principal fruits cultivated in Tropical regions. The banana, pine-apple, citrus fruits, olive and fig have been excluded from the work as they have been fully dealt with in other publications.

This work contains much very valuable information concerning tropical fruits. Our present knowledge of tropical fruits is superficial, mainly because workers upon the improvement of fruits in one part of the world have had no experience of the varieties of fruits to be found in other tropical lands. While travelling as Agricultural Explorer for the United States Department of Agriculture a considerable amount of first hand information has been collected together by the author who also has had advantage of practical growing of tropical and sub-tropical fruits in California and Florida.

The chapters on the mango, avocado, anonaceous fruits, loquat, papaya and mangosteen are of particular interest to Ceylon and show what is being done in other countries to improve their varieties of fruits. Much of the fruit of Ceylon is excessively poor in comparison with the fruit of other tropical lands, and workers who will attempt to improve conditions are required.

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* *The Bases of Agricultural Practice and Economics in the United Provinces, India*, by H. MARTIN LEAKE, M.A., Sc. D., F.L.S., W. Heffer & Sons, Cambridge.

† *Manual of Tropical and Sub-tropical Fruits* by WILSON POPENOE, MACMILLAN COY., 1920, Price 30/-

# THE CEYLON

## STATEMENT OF RECEIPTS

| PARTICULARS | | | TOTAL Rs. | Cts. |
|---|---|---|---|---|
| RECEIPTS :— | | | | |
| A.—GOVERNMENT GRANT | | | 52,010 | 00 |
| B.—OTHER CHARGES :— | | | | |
| 1. PUBLICATION AND PRINTING :— | | | | |
| (*a*) Tropical Agriculturist | | | 215 | 20 |
| (*b*) Govikam Sangarawa | | | 711 | 44 |
| (*c*) Tamil Magazine | | | — | — |
| (*d*) Year Book | | | 20 | 05 |
| (*e*) General Printing | | | — | — |
| (*f*) Advertisements | | | 2,060 | 90 |
| 2. SUPPLIES OF IMPLEMENTS, PLANTS & SEEDS :— | | | | |
| (*a*) Implements | | | 2 | 00 |
| (*b*) Plants | | | 249 | 40 |
| (*c*) Seeds | | | 10,493 | 62 |
| 3. AGRICULTURAL INSTRUCTIONS :— | | | | |
| (*a*) Expt. Gardens | | | 10 | 43 |
| (*b*) Apiculture | | | — | — |
| (*c*) Sericulture | | | — | — |
| 6. MISCELLANEOUS :— | | | | |
| (*a*) Stationery & Books | | | 8 | 17 |
| (*b*) Post & Telegrams | | | 16 | 07 |
| (*c*) Furniture | | | — | — |
| (*d*) Bank Interest (including Fixed Deposits) | | | 830 | 81 |
| (*f*) Incidentals | | | 207 | 90 |
| SUBSCRIPTIONS :— | | | | |
| Foreign | | | 7,737 | 30 |
| Local | | | 5,528 | 64 |
| NEW INSTRUCTORS :— | | | | |
| Donation by Kalutara F. P. Committee | | | 510 | 00 |
| Supplementary Grant (Temporary Increases) | | | 8,547 | 00 |
| Fixed Deposit (from conversion) | | | 8,022 | 94 |
| Refund of Petty Cash Imprest | | | 400 | 00 |
| | | | 97,581 | 87 |
| Balance from 1919 | | 735·17 | | |
| Over Credits less Bank Commission from July to Dec. | | 5·51 | | |
| | | | 740 | 68 |
| | | | 98,322 | 55 |

IN BANK :—
On Fixed Deposit Rs. 5,000/-

Examined under my direction and found correct.

Sgd. W. W. WOODS,
*Colonial Auditor.*

June, 1921.

# AGRICULTURAL SOCIETY.

## AND EXPENDITURE FOR 1920.

| PARTICULARS | TOTAL Rs. | Cts. |
|---|---|---|
| EXPENDITURE :— | | |
| A.—PERSONAL EMOLUMENTS :— | 43,473 | 61 |
| B.—OTHER CHARGES :— | | |
| 1. PUBLICATIONS & PRINTING :— | | |
| (*a*) Tropical Agriculturist - - | 7,599 | 57 |
| (*b*) Govikam Sangarawa - - | 905 | 00 |
| (*c*) General Printing - - | 157 | 31 |
| (*f*) Advertising - - | 4 | 14 |
| 2. SUPPLIES OF IMPLEMENTS, PLANTS & SEEDS : | | |
| (*a*) Implements - - | 76 | 07 |
| (*b*) Plants - - | 357 | 20 |
| (*c*) Seeds - - | 8,285 | 85 |
| 3. AGRIC. INSTRUCTION :— | | |
| Expt. Gardens - - | 1,314 | 93 |
| 5. TRAVELLING :— | | |
| (*a*) Secretary - - | 1,038 | 57 |
| (*b*) Agric. Instructors - - | 7,000 | 59 |
| Temp. ,, - - | 15,311 | 39 |
| (*c*) General - - | 1,512 | 92 |
| 6. MISCELLANEOUS :— | | |
| (*a*) Stationery & Books - | 1,174 | 23 |
| (*b*) Post & Telegrams - - | 2,763 | 04 |
| (*c*) Furniture - - | — | — |
| (*d*) Bank Charges & Commission - | 88 | 66 |
| (*e*) Audit of Accounts - - | 300 | 00 |
| (*f*) Incidentals - - | 1,269 | 50 |
| (*g*) Seed Store - - | 361 | 12 |
| | 92,993 | 70 |
| Advance P. C. I. - - | 400 | 00 |
| | 93,393 | 70 |
| By Balance (Forward) - - | 4,928 | 85 |
| | 98,322 | 55 |

Sgd. M. KELWAY BAMBER,

Peradeniya, January, 1921. *Secretary, Agricultural Society.*

# ANIMAL DISEASE RETURN FOR THE MONTH ENDED 30th June, 1921.

| Province, &c. | Disease. | No. of Cases up to date since Jan. 1st. 1921. | Fresh Cases | Recoveries. | Deaths. | Balance Ill. | No. Shot. |
|---|---|---|---|---|---|---|---|
| Western | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 82 | 1 | 82 | — | — | — |
| | Anthrax | — | — | — | — | — | — |
| Colombo Municipality | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 88 | — | — | — | — | — |
| | Anthrax | — | — | — | — | — | — |
| | Rabies | 2 | — | — | — | — | — |
| Cattle Quarantine Station | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 51* | 4 | Up to | June | 20th | 1921 |
| | Anthrax | 243† | 43 | | | | |
| Central | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 13 | 4 | 5 | — | 8 | — |
| | Anthrax | — | — | — | — | — | — |
| | Peroplasmosis | 6 | 6 | — | 3 | 3 | — |
| Southern | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 35 | — | 35 | — | — | — |
| | Anthrax | — | — | — | — | — | — |
| Northern | Rinderpest | Free | | | | | |
| | Foot-and-mouth disease | | | | | | |
| | Anthrax | | | | | | |
| Eastern | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 141 | — | 141 | — | — | — |
| | Anthrax | — | — | — | — | — | — |
| North-Western | Rinderpest | 36 | — | 11 | 23 | — | 2 |
| | Foot-and-mouth disease | — | — | — | — | — | — |
| | Anthrax | — | — | — | — | — | — |
| North-Central | Rinderpest | Free | | | | | |
| | Foot-and-mouth disease | | | | | | |
| | Anthrax | | | | | | |
| Uva | Rinderpest | — | — | — | — | — | — |
| | Foot-and-mouth disease | 392 | — | 382 | 10 | — | — |
| | Anthrax | — | — | — | — | — | — |
| Sabaragamuwa | Rinderpest | Free | | | | | |
| | Foot-and-mouth disease | | | | | | |
| | Anthrax | | | | | | |

* 7 cases occurred amongst sheep and goats. † occurred amongst sheep and goats.

Colombo, 6th July, 1921.

G. W. STURGESS, G.V.S.

# METEOROLOGICAL.

## JUNE, 1921.

| Station | Temperature: Mean Daily Shade | Temperature: Difference from Average | Mean Humidity | Mean amount of cloud 0=clear, 10=overcast | Mean Wind Direction during month | Daily Mean Velocity. | Rainfall: Amount | Rainfall: No. of Rainy days | Rainfall: Difference from Average |
|---|---|---|---|---|---|---|---|---|---|
| | ° | ° | % | | | Miles. | Inches | | Inches |
| Colombo Observatory | 83·0 | + 1·4 | 78 | 8·3 | WSW | 168 | 1·50 | 13 | - 6·59 |
| Puttalam | 83·5 | + 1·3 | 77 | 5·3 | SW | 318 | 0·92 | 2 | - 0·84 |
| Mannar | 85·8 | + 1·1 | 73 | 7·2 | SSW | 210 | 0·00 | 0 | - 0·60 |
| Jaffna | 84·8 | + 1·0 | 82 | 4·2 | SSW | 391 | 0·22 | 2 | - 0·49 |
| Trincomalee | 86·2 | + 0·6 | 66 | 6·7 | SW | 265 | 2·75 | 4 | + 1·47 |
| Batticaloa | 86·0 | + 0·8 | 64 | 4·7 | SE | 147 | 0·57 | 4 | - 0·46 |
| Hambantota | 83·0 | + 1·5 | 76 | 5·0 | WSW | 434 | 0·39 | 5 | - 1·95 |
| Galle | 81·0 | + 0·4 | 82 | 4·7 | WNW | 332 | 4·75 | 18 | - 3·49 |
| Ratnapura | 81·2 | + 0·6 | 82 | 7·6 | — | — | 13·05 | 26 | - 6·83 |
| Anu'pura | 84·1 | + 0·9 | 72 | 5·2 | — | — | 0·64 | 4 | - 0·77 |
| Kurunegala | 81·6 | + 0·7 | 79 | 6·4 | — | — | 3·06 | 16 | - 5·27 |
| Kandy | 77·7 | + 1·1 | 78 | 6·9 | — | — | 2·73 | 22 | - 6·86 |
| Badulla | 75·5 | - 0·1 | 74 | 6·8 | — | — | 3·84 | 7 | + 1·57 |
| Diyatalawa | 70·7 | + 0·3 | 70 | 4·9 | — | — | 3·85 | 6 | + 1·81 |
| Hakgala | 62·6 | + 0·8 | 84 | 6·8 | — | — | 2·73 | 15 | - 4·97 |
| N. Eliya | 61·6 | + 1·7 | 85 | 8·8 | — | — | 6·18 | 24 | - 6·62 |

In June, as in May, the main fact of the month has been a deficit in rainfall in those parts of the Island where the averages are high.

Roughly if a line is drawn from Chilaw eastward to Matale and thence from a little East of Matale southward to Tangalle the area South-West of it was from 5 inches to 10 inches in deficit. In that area at a few stations the deficit exceeded 10 inches and at even fewer it was less than 5 inches.

As regards actual quantities Watawala recorded 33 inches (June average 38 inches) and 'Kenilworth" and "Blackwater" (Nawalapitiya) had approximately 30 inches each followed by Kitulgala 28 inches and Padupola 27 inches. Between the 3rd and the 8th a number of stations in the above neighbourhood recorded over 5 inches in a day but the list of such falls is about half as long as the corresponding one for last June.

One adjunct of the monsoon's failure to deposit the usual amount of rain on the windward side of the Island has been that the usual shielding effect has been less marked on the lee side.

The number of stations that recorded nothing is much smaller than in May and if a line is drawn from Mullativu through Mihintale, Dambulla and Alutnuwara to Diyatalawa the area East of it had for the most part above its average rainfall, though this does not mean a great water supply, as the averages themselves ere low, e.g. Vakaneri is 5·82 inches above average with a rainfall of 7·04 inches and an average of 1·22 inches.

The wind velocity was above the average—in the case of the southern stations considerably so—and there was nothing very unusual in the mean wind directions.

Humidity was very noticeably in deficit particularly at the coast stations, and Temperature was consistently above normal.

A. J. BAMFORD,
Supdt. Observatory